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Some Implications of
LAND TENURE
in the
Longleaf Pine Area of Mississippi

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By

D. GRAY MILEY

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ACKNOWLEDGMENTS

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Mr. H. P. Todd, Mr. W. G. O'Leary, and Mr. H. J. Putnam of the Department of Agricultural Economics assisted with the field work. In addition Mr. Todd prepared many of the tables that appear in the report. Personnel of the Regional Staff assisted with the field work and tabulated the major part of the material used.

Dr. Frank J. Welch has given helpful supervision during the conduct of the project and the preparation of the manuscript.

Some Implications of Land Tenure in the Longleaf Pine Area of Mississippi

By

D. Gray Miley

This study is part of a Regional Land Tenure Research Project which was organized for the purpose of studying land tenure problems in an area covering five states. The interest in and the importance of land tenure in this area is due to the high percentage of tenancy in each state. In Mississippi for example, 66 percent of the farms operated in 1940 were operated by tenants. The percentage of tenants was much higher for negroes (85 percent) than for whites (43 percen). (See tables 1 and 2). It is recognized that the particular forms of tenancy and perhaps many of the problems will be different in the various states comprising the area. However, it was hoped that by studying these problems over a wide area it might be possible to arrive at a more workable classification of tenants as well as some

Table 1. Number of white farmers and percentage of tenancy among white farmers, Mississippi, and selected areas, 1920, 1930, 1940

Area	1920		1930		1940	
	All white farmers	Percent tenants	All white farmers	Percent tenants	All white farmers	Percent tenants
State	110,882	37.8	129,775	50.4	131,552	43.1
Longleaf Pine Area	16,456	25.7	19,260	39.6	21,366	34.0
Jefferson Davis County	1,039	21.6	1,207	40.8	1,304	36.1
Marion County	1,233	25.2	1,618	39.0	2,030	32.4

Source: United States Census of Agriculture, 1920, 1930, 1940.

Table 2. Number of Negro farmers and percentage of tenancy among Negro farmers, Mississippi, and selected areas, 1920, 1930, 1940

Area	1920		1930		1940	
	All Negro farmers	Percent tenants	All Negro farmers	Percent tenants	All Negro farmers	Percent tenants
State	161,219	85.5	182,888	87.6	159,540	85.3
Longleaf Pine Area	8,888	60.5	11,162	65.8	11,638	63.5
Jefferson Davis County	1,233	58.3	1,706	69.0	1,529	66.0
Marion County	653	45.6	985	56.3	1,099	55.1

Source: United States Census of Agriculture, 1920, 1930, 1940.

of the basic principles involved in the division of the rights in land.

For the Regional study, samples were taken in the areas of each state that were thought to be representative of larger regions. The area in Mississippi was selected to represent the Coastal Plains region. The counties selected for study are in the Longleaf Pine type-of-farming area and for this reason, in the Mississippi study, these counties were considered to be representative of this area; for the Regional study, they will be considered as representative of the Coastal Plains region.

Marion and Jefferson Davis counties were considered to be representative of the Longleaf Pine area. In these counties 20 different neighborhoods were selected for intensive study. These 20 neighborhoods give a representative picture of farming and tenure conditions as they exist in these counties. As nearly as possible, all of the farmers in each of these neighborhoods were visited and information obtained on a farm and family schedule. Complete information was obtained on the operations of the farm as well as the tenure status of the farmers and other conditions pertaining to the family and its participation in community affairs. In fact, every bit of information that it was thought might be helpful in an analysis of the entire farm and tenure status of these families was obtained.

For the Mississippi study, a total of 327 schedules was obtained; the information on the operations of the farms was for the crop year 1942. (See table 3). These schedules were all edited and the information coded on punched cards in the Regional office of the Land Tenure Research Project at Fayetteville, Arkansas. Tabulations of this material have been made in the Regional office and made available to workers in the individual states.

Table 3. Distribution of farmers by race and by tenure status,[1] sample farm, Mississippi, 1942

Race	Tenure						Total
	Owners			Renters	Croppers	Laborers	
	Full owners	Part owners	Total				
White	116	15	131	24	29	0	184
Percent	63.0	8.2	71.2	13.0	15.8	..	100.0
Negro	36	19	55	15	58	6	134
Percent	26.9	14.2	41.0	11.2	43.3	4.5	100.0
Total	152	34	186	39	87	6	318
Percent	47.8	10.7	58.5	12.3	27.4	1.9	100.0

[1] The tenure status of 9 farmers is indeterminate. These are omitted in this table, and will usually be omitted hereafter.

In Mississippi, a considerable number of other tabulations have been made to go along with those furnished by the Regional office. This report is based on the information obtained from the Regional office as well as tabulations made in the State from data obtained in the two Mississippi counties. Each of the other states plans to issue reports on the work done in their state and, in addition, a regional report or reports will be issued in which the results of the work done in all of the states will be summarized and analyzed. The main objective in the Mississippi portion of this study is to show the physical and human resources of each of the tenure classes and to determine the use that each class is making of its resources. The main emphasis was placed on the economic side of the entire operation. An attempt was made to determine the producing ability of the several tenure groups and to show how the production, and in turn the economic well-being of these families might be improved. Many other factors such as the participation of the family in community affairs, the level of education, the stability of the farm family, and other important factors were taken into account in an effort to fully explain the situations studied.

Historical Development[1]

The Longleaf Pine area is made up of 11 counties in the south central part of the State of Mississippi. (See figure 1). As the name implies, this area was formerly covered with longleaf pine forests. The importance and value of these forest resources were not realized until many years after the area was settled. In fact, to the early settlers, the large longleaf pines were considered to be more of a liability than an asset. With the equipment available at the time the first settlers came into the area, it was a difficult job to clear the land of the virgin trees so that it could be cultivated.

Both Marion and Jefferson Davis Counties were originally a part of Washington County which was established in 1800. This county was in what was at that time the Southeast corner of the newly organized Mississippi territory. At the time this county was established, much of the territory was still owned and occupied by the Choctaw Indians. After the Louisiana Purchase of 1803, attempts were made to establish land routes from this new territory to New Orleans and to Natchez. The establishment of these routes made it necessary to acquire some of the Choctaw land. In 1805, the United States Government purchased around 4,000,000 acres of land in Southern Mississippi for the sum of $55,500. This was known as the first Choctaw Cession and both Marion and Jefferson Davis Counties have been created from lands included in this first purchase.

Marion County was created in 1811 and was named for General Francis Marion, the noted "swamp fox" of Revolutionary War days. Most of the early settlements of the Mississippi territory was concentrated along the southern border and the city of Columbia had its beginning as the center of trade for this new settlement. As the population of the State of Mississippi increased and as new counties were created, the size of Marion County steadily decreased. Much of the original area had been taken away when a part of the county was used in 1890 in the creation of Pearl River County. Other portions of the county were taken in 1904 and 1914 to form other surrounding counties.

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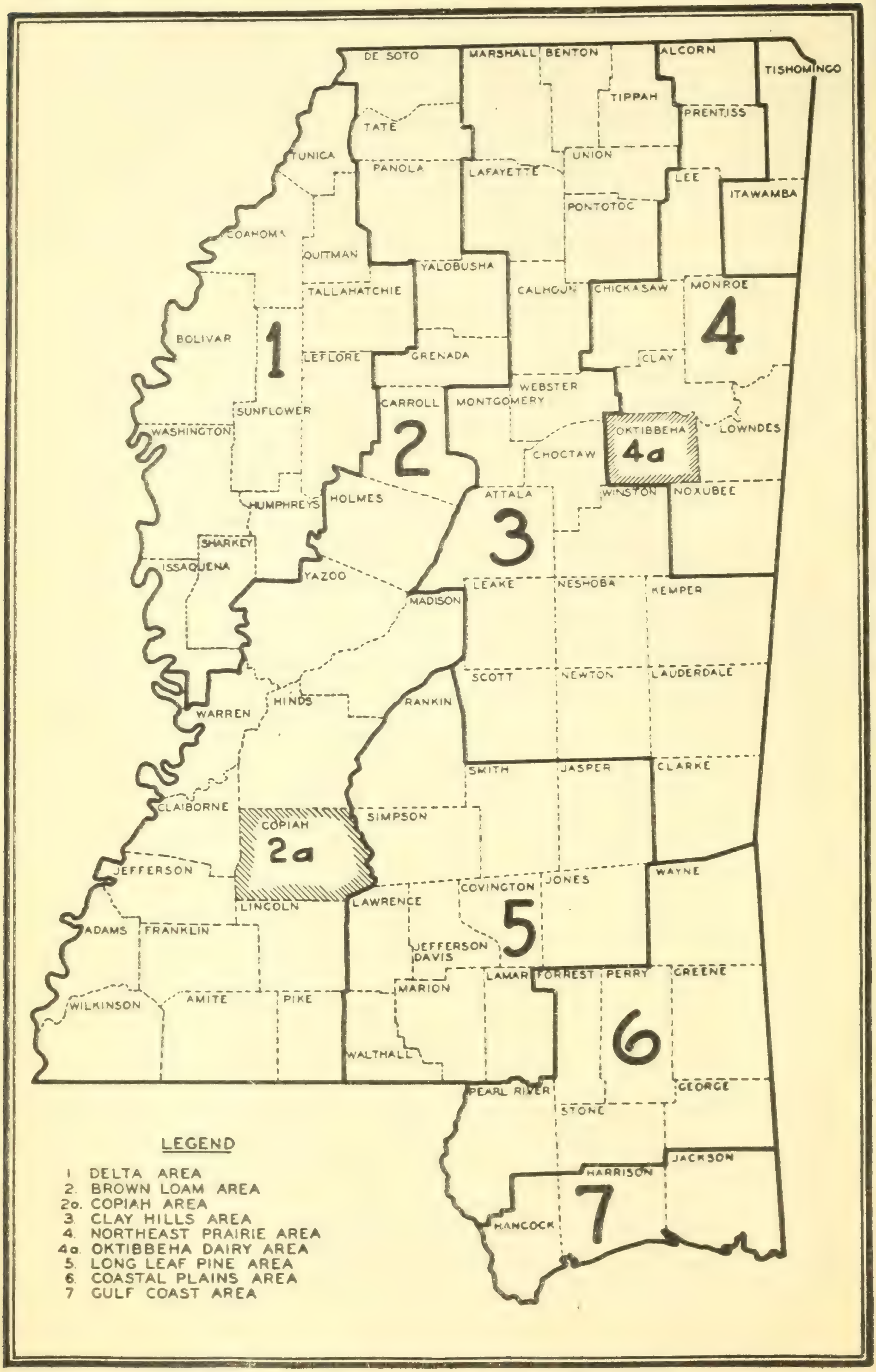
[1] Materials in sections on Historical Development, Farm Marketing Opportunities, Farm Credit Facilities, and Opportunities for Off-Farm Employment, were summarized largely from field notes taken by Raleigh Barlow, of the Regional staff.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GEORGE
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7
HANCOCK
LEGEND
1 DELTA AREA
2. BROWN LOAM AREA
2a. COPIAH AREA
3. CLAY HILLS AREA
4. NORTHEAST PRAIRIE AREA
4a. OKTIBBEHA DAIRY AREA
5. LONG LEAF PINE AREA
6. COASTAL PLAINS AREA
7 GULF COAST AREA

Figure 1 Type-of-farming areas in Mississippi

Jefferson Davis County has a short history as a county because it was not created until 1906 when it was formed from parts of Covington and Lawrence Counties.

The first permanent settlers came into this area around 1800. Some of the old homes that are still standing were built between 1795 and about 1810. The surveying of the area and the opening up of the land for settlement around 1811 and 1812 together with the location of the Jackson Military Road in 1815 helped to bring in a large number of settlers.

By 1820, Marion County with twice its present area had a population of 3,116. After 1820, however, the population increased very slowly and it was not until 60 years later, in 1880, that the population had doubled itself. (See table 4).

Much of the land in this area was bought from the government at public auction by settlers at the minimum rate of $1.25 per acre. However, as was the case in many other areas, a considerable portion of the land in Southern Mississippi was bought by speculators. By the time the Homestead Act became applicable soon after its passage in 1862, there seems to have been little unpatented land left in the area.

Table 4. Total population of Marion and Jefferson Davis Counties by color for census years

	Marion County			Jefferson Davis County		
Year	Total	Whites	Negroes	Total	Whites	Negroes
1820	3,116	1,884	1,232	-------		
1830	3,691	1.970	1,721	-------	-------	
1840	3,830	2,121	1,709	-------	-------	-------
1850	4,410	2,215	2,195	-------	-------	-------
1860	4,686	2,500	2,186	-------	-------	
1870	4,211	2,562	1,649	-------	-------	
1880	6,901	4,450	2,451	-------	-------	
1890	9,532	6,530	3,002	-------	-------	-------
1900	13,501	9,178	4,323	-------	-------	-------
1910	15,599	9,534	6,063	12,860	6,009	6,751
1920	17,144	11,025	6,119	12,775	6,004	6,751
1930	19,923	12,306	7,617	14,281	6,380	7,901
1940	24,085	15,161	8,923	15,869	7,087	8,782

Source: United States Census.

A large proportion of these early settlers came from North and South Carolina. For the most part, they located their farms along the Pearl River or the smaller streams of the area. As mentioned earlier, the process of clearing the land was usually slow but the better fixed of the settlers were able to establish plantations which they operated with a few slaves.

It was not until shortly before the War Between the States that cotton became an important crop commercially in this area. Difficulties of transportation made it almost impossible to get cotton to the ports for exportation. The principal crops grown were corn, rice, sweetpotatoes, and garden vegetables. The major sources of income were from cattle, sheep, wool, and timber. However, about the time of the War Between the States, steamboats began to navigate Pearl River and with this development along with the importance of New Orleans as a cotton market, this crop became the most important source of income for the entire area.

South Central Mississippi did not feel the direct effects of the War Between the States in the same way as did many other sections of the South. Many of the local sons took part in the war but no battles were fought in the vicinity of either of the counties studied. However, the entire area suffered from the economic and social dislocations that came after the war. Some of the negroes stayed with their former masters and became sharecroppers, but as was the case in other areas throughout the South, many of the planters were bankrupt by high taxes and 4 years of warfare and the farms of several of these were divided into smaller farms. Even though this was never an area of large plantations, many of the farmers had a few slaves. The problem of how to handle these emancipated slaves was similar to those faced by other areas throughout the South. Many of the negroes wanted to become farm owners but lacked the necessary capital as well as managerial ability to operate the farms. Other negroes were willing to work for wages but the landlords were frequently not able to pay even the small amount of wages that was demanded.

Under these circumstances, the sharecropping system along with the furnish system gradually developed in this area. However, the sharecropping system as it now exists, probably did not come into existance overnight. The principle of the working agreement between the landlord and the tenant was developed rather soon after the close of the War Between the States and the emancipation of the slaves. However, the terms of the agreement by which the owner and the sharecropper divide the proceeds of the crop have varied from time to time. The almost universal practice that has come to be accepted is for the sharecropper who furnished all the labor but no equipment to get half the crop, and the sharecropper who furnishes the labor and equipment to get two-thirds of the cotton and three-fourths of the corn. In each case the other shares go to the landlords for furnishing the land and probably some seed and fertilizer.

As was indicated earlier, the growth of population was relatively slow between 1820 and 1880. In 1880 only about two percent of the land in Marion County was cleared and improved. The progress made since that time is closely associated with the great timber boom that started in Southern Mississippi about that time. The value of the pine forests was finally realized and a land boom resulted from speculators attempting to gain control of the standing forests. Some of the land passed into the hands of residents of the county but the greater portion was bought by Northern capitalists. Previous to this time only a small lumber industry had existed in Marion County to supply the local needs.

The commercial sawmill business did not really get started until after 1890 and the real growth came after the building of the first railroads into this area between 1900 and 1906. As the lumber industry boomed, the population increased. A large number of sawmills were located along the railroads in both counties. Many of the larger mills built short spur logging lines that connected with the main lines of the railroads. These large lumbermen worked with dozens of smaller timber operators and often employed hundreds of men. Some of these larger operators cut over pine land at the rate of 20 to 30 acres a day and their operations left vast areas of cut over land.

As the lumber operators moved on, much of this land was cleared and put into cultivation. (See table 5) The percentage of the total.land area in farms in Marion County increased from 33.7 in 1890, to 58.7 in 1940. The increase in cropland in this area has been greater in recent years than in any other area of the State. Along with this increase, the size of the average farm decreased from 165 acres in 1890, to 66 acres in 1940. The number of farm operators in the two sample counties has increased steadily. (See table 6). The number of full owners in Jefferson Davis County increased only slightly between 1920 and 1940; whereas the total number of tenants almost doubled during this period, thus accounting for most of the increase in the number of farm operators. On the other hand, the number of full owners in Marion County increased 47 percent between 1920 and 1940 and, in addition, the number of tenants doubled during this period. (See table 7).

Table 5. Total cropland[1], and percentage increase, in specified areas, 1924, 1929, 1939

Area	1924 acres	1929 acres	1939 acres	Increase 1924-39 acres	Percent increase
State except Delta Area	5,073,462	5,444,228	5,959,066	885,604	17.5
Longleaf Pine Area	697,124	747,830	899,261	202,137	29.0
Jefferson Davis County	69,548	78,295	89,691	20,143	29.0
Marion County	50,723	66,793	84,163	33,440	65.9

[1] Total cropland includes harvested, failure, and idle.

Source: United States Census of Agriculture, 1925, 1930, 1940.

Complete information on the number of sharecroppers by census years is not available but the available information indicates that the number of croppers has increased about the same proportion as the number of tenants. Jefferson Davis County has consistently had the highest percentage of tenancy, but tenancy has steadily increased in Marion County as more land has been cleared for farming.

The boom years for the lumber industry came to an end during the 1920's. In other words, it took 20 to 30 years for the lumber

Table 6. Farmers and farm population of Marion and Jefferson Davis Counties by color for selected census years.

Year	Farm operators			Farm population		
	Total	Whites	Negroes	Total	Whites	Negroes
			Marion County			
1880	857	--------	--------	--------	--------	
1890	1,238	--------	--------	--------	--------	--------
1900	1,781	1,263	518	--------	--------	--------
1910	1,955	1,262	693	--------	--------	--------
1920	1,886	1,233	653	--------	--------	--------
1925	1,991	1,308	683	--------	--------	--------
1930	2,603	1,618	985	12,774	7,909	4,865
1935	3,000	1,948	1,052	--------	--------	--------
1940	3,129	2,030	1,099	15,155	9,406	5,749
			Jefferson Davis County			
1910	1,987	907	1,080	--------	--------	--------
1920	2,272	1,039	1,233	--------	--------	--------
1925	2,454	1,116	1,338	--------	--------	--------
1930	2,913	1,207	1,706	13,122	5,539	7,538
1935	2,958	1,387	1,571	--------	--------	--------
1940	2,833	1,304	1,529	14,150	5,994	8,156

Source: United States Census.

Table 7. Tenure status of farm operators in Marion and Jefferson Davis Counties, Mississippi, by census years, 1880 to 1940.

Census year	Full owners	All tenants	Number of sharecroppers	Percentage of tenancy
		Marion County[1]		
1880	724	133	--------	15.5
1890	937	301	--------	24.3
1900	1,328	343	--------	19.3
1910	1,309	545	--------	27.9
1920	1,198	609	332	32.3
1925	1,146	743	475	37.3
1930	1,268	1,186	--------	45.6
1935	1,443	1,412	771	47.1
1940	1,763	1,264	869	40.4
		Jefferson Davis County[2]		
1910	1,140	789	--------	39.7
1920	1,229	941	500	41.4
1925	1,226	1,157	833	47.1
1930	1,139	1,670	--------	57.3
1935	1,109	1,778	1,125	60.1
1940	1,266	1,480	966	52.2

[1] Marion County lost approximately half of its total area in boundary changes made in 1890, 1904, and 1914. The above figures are for the whole county at the date of the census enumerations.

[2] Jefferson Davis County was not created until 1906.

interests to cut out the virgin timber in this area. The big operators finished cutting out their holding and most of the large as well as the small operators closed down their mills and moved out or turned to some other form of business, while their logging and sawmill crews were scattered to other areas or settled down as farmers on the lands they had helped to clear. Sawmills and lumber processing plants are still important industries in the area, but the large-scale operations involving the cutting and processing of the virgin longleaf yellow pine are now a thing of the past.

Many of the towns and cities of South Mississippi were born of and grew out of sawmill operations and many of these once prosperous municipalities are now becoming ghost towns. The city of Columbia with its 4,000 inhabitants confronted this bleak industrial future around 1928 when the largest lumber company in the area faced the possibility of closing down and throwing its 800 employees out of work. However, under the leadership of a number of citizens, several industries have been established in Columbia that give employment to more people than were formerly employed by the lumber company. A knitting mill, a vegetable canning plant, a large garment factory, a pickle plant, a naval stores plant along with several other small industries are now located in and around the city of Columbia.

Because of the fact that a large proportion of the land in this area was not cleared of timber until about 20 to 35 years ago, many of the farms as well as the settlers are fairly new when compared with other agricultural areas of the State. This type of development has led to a fairly large number of small owner-operated farms. Many of the former employees of the sawmills bought small tracts of the cut over land and settled down to farm. This pattern of development gives in this area a group of the descendants of the old settlers that came into the area around 100 years before the timber boom got under way along side of those who came into the area and settled on the cut over land.

The negro population declined during the War Between the States but most of the freed slaves stayed in the area after the close of the war. It is interesting to know that many of these negroes were able to acquire land and in some instances have built solid neighborhoods of colored negro owners. In a few cases, there are neighborhoods where there are both white and negro owners. Other negroes became sharecroppers and farm wage hands and in many other cases they were able to secure employment in the sawmills and with logging crews. As mentioned earlier, this has never been a typical plantation area. Rather it is an area where there are some communities in which farms of the plantation type prevail. These are usually the old communities. However, along with these there are other communities where small individually owned and operated farms prevail. In the old plantation-type communities, some of the planters use white tenants and croppers while in some cases whites and negroes are used on the same farm. On the larger farms, however, there seems to be a distinct preference for colored sharecroppers. The reason for this preference may be found in the fact that negroes are usually less resentful of supervision, they are usually less inclined to complain, and in many instances their demands for housing are less than those of white croppers.

Problems of race conflict exist in Southern Mississippi just as they exist in practically every other area where negroes and whites associate on a comparatively equal economic footing. The enumerators in this study observed very few cases in which these conflicts were allowed to get out of control. In the solid white and solid negro operator neighborhoods, a considerable amount of friendliness, mutual respect, and willingness to cooperate in the operations of the other race were encountered. Friction is usually found in mixed neighborhoods, particularly in cases where white operators work as tenants or croppers alongside negroes. The feelings of the white man on the race question are more apt to become aroused if his colored neighbor is able to achieve a higher economic status. Where negroes and whites operate in the same community on fairly equal terms as operators or as tenants, there is always considerable opportunity for conflicts of interest to develop as a result of competition and often of jealousy.

Farm Marketing Opportunities

The availability of marketing opportunities has a close relationship to the conditions determining land tenure status but this relationship is exerted indirectly rather than directly. Many factors both physical and economic have their influence upon the combination of enterprises to be used in any area or on any individual farm. The principal economic factors involved are marketing opportunities, transportation facilities, and the use of capital and credit.

Marketing outlets together with the necessary transportation facilities are very important factors influencing the choices between competing enterprises and it is through these choices that the tenure status is often determined. Marketing opportunities act to provide or deprive the farmer of alternative enterprises that he can choose between when he selects the particular combination of crop and livestock enterprises that he will use. From this particular combination of farm enterprises and the proportioning of the factors of production between them, the farmer gets his annual income. The amount of this income determines in a very large measure whether the farmer will be in position to acquire farm real estate and farm capital.

Since marketing opportunities influence the enterprise pattern and consequently the level of his income, they exert a very important indirect influence on the tenure status. Ordinarily, crops are not raised commercially in any area until the markets and transportation facilities necessary for handling the crops are developed. An excellent example of this is given in the history of Marion and Jefferson Davis Counties where cotton has been the main cash crop for many years. The lack of marketing opportunities for other crop and livestock enterprises has been a major determining factor in continuing cotton as the only important cash crop.

The tenure changes that can come with changes in marketing opportunities usually come slowly as new markets are realized. There is probably very little prospect that the cotton economy in this area will be disrupted by the introduction of new enterprises but the more complete utilization of the soil and the labor available depend upon the introduction of other enterprises that do not have to compete directly with cotton. However, the successful introduction of many new enterprises depends upon the successful establishment of marketing opportunities.

In those cases where new crop or livestock enterprises together with market outlets can be introduced, there are opportunities for bringing about changes in the tenure status of many of the operators through increasing the farm income. As is well known, the cotton crop calls for high labor requirements during relatively short periods of the year and the farmers success is determined very largely by the prices that he gets for his cotton crop. In many cases, it might be possible for him to improve his tenure status by supplementing his cotton enterprise with other crop or livestock enterprises that will more fully utilize the farm labor. However, changes of this kind usually proceed rather slowly because farmers are reluctant to change from crops that they know how to grow and which are fairly sure to bring in an income to new enterprises that they know very little about.

In the area studied, the facilities for handling the cotton crop are adequate. There are marketing and processing facilities within fairly reasonable distances to all the farms in the two counties. Practically every farm in the two counties studied grows cotton and all farmers can find a ready market for their cotton as soon as it is ginned if they care to sell it at that time.

In addition to facilities for handling cotton, some marketing facilities are available for other enterprises. Grading stations for Irish potatoes are located at the main shipping points in Marion County. Columbia has a fairly well developed Irish potato market. The vegetable canning plant at Columbia also offers a ready market for such crops as snap beans, spinach, turnip greens, crowder peas, pimiento peppers and sweetpotatoes. The production of these specialty crops is found on a much larger proportion of owner operated farms than on tenant farms. In fact, practically all of the farm operators receiving high incomes from truck crops are owners.

From a consideration of the 1942 crop values and farm net worth, there is very little indication that the addition of these specialty crops has had much effect upon tenure status. The farm owner who raised these specialty crops seemed to be only slightly better off than the average for the two counties. However, the study of these farms during this one year does not provide sufficient information on which to justify the conclusion that there is no relationship between the use of these new marketing opportunities and tenure status. In order to have conclusive information on this point, it would be necessary to study the tenure process over a period of time.

The production of livestock in this area is found almost entirely on owner operated farms. The tenant or cropper always stands at a disadvantage compared to the owner when it comes to participating in livestock enterprises. The tenure system developed for cotton and long practiced in this area, does not fit in with a livestock economy. Under such a system, it is practically impossible for sharecroppers to have the advantage of the use of livestock enterprises of any kind. Such a situation raises the question of whether or not sharecroppers can make any constructive use of the opportunities furnished by additional marketing facilities.

In conclusion it can be said that, in general, the sharecropper or tenant is at a disadvantage as compared with the owner when it comes to making decisions about the use of new marketing opportunities. In this respect, tenure status can be said to have as much or more influence upon the use of marketing facilities as the use of these facilities has upon the determination of tenure status. In other words, the establishment of new marketing opportunities does not enable the tenant or sharecropper to advance himself along the agricultural ladder unless the tenure system under which he operates is such that he can change his combination of enterprises so as to take advantage of the added opportunities. Apparently from such information as is available from the studies made in these counties, the small owners, sharecroppers, and tenants have not been in position to take full advantage of the opportunities offered by additional markets for truck crops, Irish potatoes, or livestock and livestock products. This conclusion is substantiated by the fact that, for the most part, these enterprises are found on owner-operated farms and are less prevalent in those communities that have a plantation system.

Farm Credit Facilities

The availability and use of farm credit constitutes one of the more important factors in the determination of the tenure status of any particular farm operator. Credit problems are not new in the South; as a matter of fact, many historians have stressed the role played by credit in binding the planters of the old South to a commercial one-crop type of agriculture. The furnish system grew out of the disturbed conditions that followed the War Between the States. The problems of the South including the need for industrialization as well as many of the agricultural problems, are partly attributable to the lack of capital and the reliance of the South upon the importation of capital from other areas.

The nature of the credit facilities available to the farmers of any given area and the use made of these facilities has a definite effect upon the conditions of land tenure. Regardless of how tenure status is measured, the position of any particular individual in the scale bears a direct relationship to the availability and use of farm credit. In many instances, the use of credit facilities is one important factor that determines whether or not a farmer will be able to climb the agricultural ladder. Unless a farmer is able to progress to the point where he can have a capital investment in equipment, livestock, land, buildings, or supplies, he can do little more than remain on the lowest rungs of the agricultural ladder. The farmers who are able to ascend the ladder accumulate larger and larger amounts of capital and this increased investment represents a fund of "stored up" and "saved" labor.

Some farmers are fortunate enough to acquire capital investments as a result of good luck, inheritance, or gift. For many others, however, the climb up the agricultural ladder is a slow process that requires a lot of hard work and savings to accumulate enough capital to make the next step.

In many cases, the farmer finds it more advantageous to make use of farm credit facilities as he advances or holds his tenure status. In fact, in many cases, the availability of the credit of the proper kind and in the right amounts is a determining facor in the tenure process. As would be expected, the farmer with the greatest amount of ability is naturally in a position to make the best use of credit but the farmers in all tenure classes use credit.

The sharecropper requires advances of furnish credit to take care of his needs through the crop season. If he were not in position to get this type of credit, very likely he would be forced to offer his services as a day laborer. After a good year an ambitious cropper might invest his savings in a mule and some equipment and thus enable himself to climb to the status of a "third and fourth" renter. In order to maintain his position, he may have to borrow money on chattels and his crop to provide himself with production and consumption credit needed while he awaits the harvest of his crop. Other farmers in other cases use credit in the purchasing of new tractors and the acquisition of real estate, in financing feed programs for livestock or in many other ways to increase the size of their present enterprise or to add entirely new enterprises to their operation.

The problems of advancing to the status of farm ownership are becoming more complex all the time. Formerly land was plentiful and could be had at a very low price, but as land values continue to increase and good land becomes scarcer, the farmer who desires to own his own place has found it necessary to use more capital in his purchase transaction. In many areas in order to become an owner without the use of credit requires that a farmer accumulate his savings for nearly his entire lifetime before he has enough to buy a farm. The other alternative is to buy a farm with the use of credit that will supplement a cash down payment. Except in cases where young farmers acquire their farms by inheritance or gift or rare cases of wind-fall profits, it is almost impossible for young people who wish to enter farming to acquire a farm of their own without the use of credit.

In summary it can be generally stated that the availability and use of farm credit facilities often have a strategic influence on farm tenure status. This is particularly true in the South where the deficit supply of farm capital relative to factors of land and labor has been one of the major contributing factors to the low production of agricultural laborers and consequently, low farm incomes. One does not have to look far to see evidences of the lack of capital and the need for more adequate buildings, fences, livestock, machinery, soil and other farm improvements.

Along with the lack of adequate capital has been many cases of high costs of the available credit. The furnish system has often resulted in high interest rates which, though often justified, have resulted in hardships to those families who had to depend on this system. These interest payments, though small, in many cases represented the margin of income that might be used in a gradual accumulation of capital. It should be pointed out that in most cases these interest charges were justified on a basis of the risk involved. The main fault seems to lie with the system itself in that it tends to create conditions that make it very difficult for sharecroppers to advance themselves along the agricultural ladder and, in addition, there are many cases where farmers seem to have gotten into a state of economic bondage from which they are often not able to free themselves.

The availability of credit opportunities effect not only the tenure status of farm families but in addition, influences nearly all farmers in their choices of farm enterprise. The fact that the credit system throughout the South has always been and still is, tied to the production of cotton makes it very difficult for farm people to secure capital to start new enterprises.

In the two counties studied in Mississippi, the Federal Land Bank was the most important loan agency operating in the real estate credit field. Local banks, individuals, and other sources had a few real estate loans in 1942 but they were of very minor importance. For the most part, these real estate loans were for amounts ranging from $250 to $750. Real estate mortgage credit in these counties has been available from government sponsored agencies, banks, lumber companies, and many individuals.

Examination of the records of tracts of land purchased since 1927 indicates that all of these sources were used in some of the sample communities. There is evidence that this type of credit has been available in sufficient quantities to meet the needs of farm people in these counties. There may be some question about the quality of credit available. This factor applies particularly in cases of farmers who want to expand their operations to include new enterprises. Entrance into the livestock industry, for example, requires considerable initial investment in land, pasture development, buildings, and the livestock itself. In many of the strictly cotton areas, credit of this type on terms adapted to these new enterprises has not been readily available. From the standpoint of the credit agency, this is undesirable because they feel that the risks involved in new enterprises of this type are greater than they are for enterprises such as cotton where a long credit history is available. However, from the standpoint of a more balanced agriculture, and a fuller employment of the natural and human resources, the lack of such credit is often a seriously limiting factor.

Production or non-real estate credit has been available from landlords and merchants, local banks, Farm Security Administration, production credit associations, and emergency feed and seed loans. The use of merchant or furnish credit is much more prevalent in Marion than in Jefferson Davis County. Several large furnish merchants in Marion County have expanded their operations to include, in addition to furnishing credit, the marketing of crops involved. By providing these additional services, they have apparently been able to meet the competition of both federally sponsored and private credit agencies. On the other hand, in Jefferson Davis County, the use of credit from the Farm Security Administration, individuals and other agencies, is much more common than in Marion County.

As in the case of real estate credit, the general availability of production credit seems to be adequate to meet the needs of most individuals in these two counties. However, the quality of the credit available may not be suited to the needs of many of the individuals. For example, a study of the information available indicates that practically all of the croppers deal either with their landlords or with credit merchants for the funds they use. In most cases, the credit standing of the cropper does not permit him to get credit from any other agency and consequently, his credit choices are limited to agencies that charge high rates for the money furnished. Thus farmers who had accumulated enough capital to be renters were somewhat better off in so far as the fund from which they could supply their credit needs was somewhat larger. In spite of this fact, however, most of the renters depend upon landlord or merchant credit.

The facilities offered by the Farm Security Administration seems to be the only ones giving these old line credit sources any serious competition. When looked at as a group, the owner operators use several types of credit facilities but a large proportion of the owners in the sample studied use merchant or Farm Security Administration credit. Further examination of this showed that the smaller, less prosperous farms made the greatest use of merchant credit. The operators who had less than $1,000 equity in their farm businesses, for the most part, used merchant credit in Marion County and Farm Security Administration credit in Jefferson Davis County. The farmers with equities of over $3,000 in their farm business made a much greater use of bank and government credit, and usually the only use they made of merchant credit was in the purchase of fertilizer.

Opportunities for Off-Farm Employment

Opportunities for off-farm employment during the seasons when the available labor is not fully occupied on the farm are of major importance in the cotton economy. As has long been recognized, one of the major problems of the cotton areas in the South is the relatively small amount of the total labor available that is fully used in the production of cotton. The large amounts of labor that are required in the peak periods of chopping and picking are very often idle for the rest of the year. Unless other enterprises are introduced in the farm organization that provide fuller employment, the only other alternative is for the farm operators to seek off-farm employment or remain idle. The availability of off-farm employment is very often the determining factor in the change of farm operators from one tenure status to another. Ambitious sharecroppers or tenants that take advantage of other employment opportunities during the slack period of farming are more likely to advance along the agricultural ladder than those who simply grow their one crop of cotton and remain idle the rest of the year.

The enumerators in the Marion and Jefferson Davis County studies observed that in many cases the more prosperous farmers had regular off-farm sources of income. The enumerators in the other states, particularly Arkansas and Louisiana, observed the same situation for the area sampled in their states. This situation naturally raises the question of whether or not plans for bettering the land tenure conditions in these areas can afford to neglect giving some attention to the part that supplementary employment opportunities might have upon tenure. The greater the number of alternative choices that are available to the farmer and the more desirable these alternatives seem to be, the greater will be their effect upon the local systems of farming and the existing ratios between the population and the available land. In this connection the employment opportunities that the farmer can dove-tail into his regular farm working program are of particular importance. This alternative is very important because it makes it possible for the farmer in Southern Mississippi to supplement his regular farm income with certain off-farm receipts.

The present farming system in Southern Mississippi favors the balancing of the farm program with some off-farm work. As will be shown in some detail later, the average farmer places major reliance upon the cultivation of cotton and corn and this combination of crop enterprises seldom requires the presence of the farmer on his farm for more than 6 to 8 months during the year.

The diversification of his farming system by the addition of other crops such as Irish potatoes and sweetpotatoes, peanuts and truck crops still usually leaves him with the winter season free for some other type of employment. About the only exception to this situation is found among those farmers who have the capital, land and pasture available for adding a livestock enterprise to their farm business. Along with this availability of the average farmer for off-farm work during a portion of the year is the usual condition of low farm incomes that almost always need some supplementing from off-farm sources if the farm family is to enjoy anything more than a subsistence standard of living. In many cases it is possible for this additional income to be invested in farming equipment, livestock or land and thus improve the tenure status of the individual farmer.

At the time this study was made in 1942, opportunities available to farmers in Southern Mississippi for off-farm employment were probably greater than at any other time in the history of the settlement of Mississippi. The defense and war industries located along the Gulf Coast and the army camps in the State offered a considerable demand for employees and it was not difficult for even those farmers who possessed no particular skills to secure employment. Because of this situation the employment opportunities available at the time the study was made cannot be considered as reflecting the average or normal conditions.

During what might be considered as normal or regular times, one of the important sources of employment is that of work on other farms in the area. Many small owners, sharecroppers, and tenants find employment as farm wage hands on the larger farms in the area. This type of employment was more important in Jefferson Davis than in Marion County. In Jefferson Davis County, 45 out of the 89 farmers for which information was obtained received some income from farm work on farms other than their own; while in Marion County, only 42 of the 145 farmers from which information was obtained received an income from this type of employment. This situation is probably a reflection of the fact that opportunities for other types of employment are greater in Marion than they are in Jefferson Davis County.

Another type of employment which has always been important in this area is that which is offered by the timber industry. This industry provides the local people with an opportunity for both full time and part time employment. The Southern Naval Stores Company employs around 110 men at its plant in Columbia. In addition, a considerable number of men are employed in the stump blasting crews which provide the raw material used by this company. Other timber industries such as sawmills, pulp mills, and a container corporation located in Southern Mississippi and Northeast Louisiana offer ready markets for timber and timber products. Many farmers find part or full time employment in logging crews or other types of work in connection with these timber industries. During 1942, 42 operators in Marion County and 14 farm operators in Jefferson Davis County had receipts from work in the timber industry.

There are several other types of off-farm employment available to farmers in these two counties such as work at cotton gins and other processing plants, the construction and defense industries, and skilled and semi-skilled trades. However, perhaps the other most important single opportunity is offered by manufacturing industries in the city of Columbia in Marion County. The most important industry in this group is the Reliance Manufacturing Company, or garment factory, which in normal times employs from 500 to 800 people. A very large proportion of the persons employed are women. When this plant was first established in Columbia, approximately 85 percent of the workers lived on farms in the surrounding area. A rather large proportion of the company employees continue to come from farms. These farm women and girls come in from their homes to the plant daily, many of them coming from as far as 25 miles away from the plant. For the most part, they come in car-sharing pools and pay for their transportation to and from the plant out of their earnings. Usually, they work in 8-hour shifts and are guaranteed a minimum wage of 44 cents per hour. Within the sample secured, practically all of the women working at this plant were wives and daughters of farm owners; only a very small number of those working worked 12 months during the year. This suggests that many of the farm women look upon their work at the garment plant as temporary and seasonal rather than as permanent employment. All of the women working at the garment plant are white and, consequently, no opportunities are offered here for negro farm families.

In summary it may be said that these various alternative and supplementary employment opportunities have been used at one time or another by practically all of the farm families in the area studied. This is shown by the fact that 145 of the 187 owners and tenants in the Marion County sample and 101 of the 132 owners and tenants sampled in Jefferson Davis County reported some earnings from off-farm work during 1942. The off-farm workers represented almost 80 percent of the two respective samples. Further study of the sample indicates that the majority of those persons not working off their farms during the year were men who were over 55 years of age. The importance of these alternative and supplementary sources of income cannot be over-emphasized because the sampled area in Mississippi is an area of high man-land ratios. It is an area where the existing labor supply during the normal year is underemployed and where, as a consequence, a low and inefficient productivity per man can be tolerated. Where such a situation exists, the serious problems of low incomes, small farms together with underemployment, cannot be solved by agriculture alone without the migration of workers from the sampled areas. However, the introduction of employment opportunities that will provide farm people with alternative choices to supplement their farm income, can go a long way toward solving many of these problems.

At the present time some of the more serious problems of agriculture in the area can be partially or completely solved either by relieving the population pressure on the land so that larger farms can be operated by a smaller, more efficient, and more productive labor force with a greater reliance upon labor saving machinery, or the present small farm setup can be continued with the farmers depending on supplementary employment opportunities for a way in which to increase their present small farm incomes. Any far reaching plan for tenure reform or any other agricultural changes in Southern Mississippi should give some attention to the industrial possibilities of the area and the role that industries can play in providing farm people with alternative and supplementary employment opportunities.

Even though much of this area is fairly new from an agricultural standpoint, there is considerable evidence that the farm population is already too large in relation to the land resources for a very large average farm income under present methods of farming. The human resources of the area will be discussed fully in the next section but it should be pointed out here that the birth rate in the two sample counties is slightly more than double the rate required to maintain a stationary population. Unless employment opportunities are provided for these additional children as they become of age, it is necessary for them to remain on farms in the area where they are reared. It does not take many generations where each generation produces twice the number of children necessary to maintain itself, for the total land available in any area to be completely utilized. It is not long before the average size farm becomes so small that the average farmer cannot possibly make a very high income. Apparently this is what has been happening in the areas under consideration.

Further subdivision of the farms in order to provide for the additional children in each generation only adds more to the rather acute problem already present. Opportunities for the employment of these people either in industries within the area or opportunities for employment outside of the immediate area seem to be absolutely essential if some of the pressure of the population on the land resources is to be removed. This does not mean that there are no opportunities to increase the level of income on the existing farms by better practices and the use of machinery. It does mean, however, that with the present small size of farm and ordinarily a fairly large supply of cheap labor, the opportunities for improvement by these methods are limited by a large number of small farms. The introduction of labor saving machinery and, in most cases, the introduction of new enterprises, particularly livestock enterprises, requires a larger farm than the average size found in this area.

Human Resources

The Longleaf Pine section of Mississippi is predominantly a rural area. For the entire area, there was an average of 39 persons per square mile in 1940 compared with an average of 34 persons per square mile in 1930. (See table 8). The State of Mississippi had 46 persons per square mile in 1940 and 42 in 1930. Marion County had an average of 44 persons per square mile in 1940, which was an increase of 8 persons since 1930. Jefferson Davis County also had an increase from 34 to 38 persons per square mile between 1930 and 1940. In fact, every county in the Longleaf Pine area had an increase during this period except Lamar which showed a slight decrease in total population.

Table 8. Population and area, Mississippi and the Longleaf Pine area, 1930 and 1940

County or area	Land area square miles	Population 1940		Population 1930		Percent increase 1930 to 1940
		Total	Per sq. mile	Total	Per sq. mile	
Mississippi	47,420	2,183,796	46	2,009,821	42	15.6
Marion	550	24,085	44	19,923	36	20.9
Jefferson Davis	414	15,869	38	14,281	34	12.0
Rankin	800	27,934	35	20,353	25	37.2
Simpson	587	22,024	38	20,897	36	5.4
Smith	642	19,403	30	18,405	29	5.4
Jasper	683	19,484	29	18,634	27	4.6
Jones	706	49,227	70	41,492	59	18.6
Covington	416	17,030	41	15,028	36	13.3
Lawrence	433	13,983	32	12,471	29	12.1
Walthall	403	17,534	44	13,871	34	26.4
Lamar	500	12,096	24	12,848	26	—5.9
Longleaf Pine Area	6,134	238,669	39	208,203	34	14.6
Percent of State	12.9	10.9	----	10.4	---	17.5

The Longleaf Pine area had 13 percent of the State's population in 1940. In 1930 this area had only 10 percent of the total population of the State. These figures indicate that the population density is not quite as great in the Longleaf Pine area as for the remainder of the State, but it is significant that the rate of increase during the period between 1930 and 1940 was higher in this area than for the State as a whole.

In the two sample counties, the farm families studied have an average of 4.7 persons in the household. (See table 9). This average was the same for both white and negro families. White owner families averaged having 4.5 persons per household while the white sharecropper families had 5.3 persons per household. On the other hand, the negro owner families had 4.9 persons per household and the negro sharecroppers had 4.7 per household. Negro owners had a slightly larger number of persons per household than negro sharecroppers while white owners had somewhat smaller households than white sharecroppers.

Table 9. Households having specified number of persons by tenure group, sample farms, Mississippi, 1942

Tenure status	Number of persons in household											
	1	2	3	4	5	6	7	8	9	10	11 & over	Total
						Whites						
Owners	1	28	23	27	16	8	13	6	3	3	3	131
Renters	0	3	4	2	3	6	1	2	1	1	0	23
Croppers	0	2	2	8	5	3	3	5	1	0	0	29
						Negroes						
Owners	2	13	8	6	3	7	4	6	2	1	3	55
Renters	1	2	4	1	1	2	0	1	0	2	0	14
Croppers	1	11	9	12	7	4	6	3	2	2	1	58

At the time the study was made, the white operator families had an average of 4.4 persons at home while the negro operator families had 4.1 persons at home. (See table 10). Since the number of persons per household was the same for these two groups, this indicates that the negro households had in them a larger number of persons who were not members of the operator's family than the white households.

Table 10. Families having specified number of members at home, by tenure groups, sample farms, Mississippi, 1942

Tenure status	Number of members at home									
	1	2	3	4	5	6	7	8	9	10 & over	Total
						Whites					
Owners	1	30	30	23	16	8	12	4	2	5	131
Renters	2	4	3	2	3	6	1	2	1	0	23
Croppers	2	2	3	9	3	3	3	3	1	0	29
						Negroes					
Owners	2	17	10	6	5	4	1	5	2	3	55
Renters	2	2	4	1	1	2	0	1	1	0	14
Croppers	2	13	15	9	6	4	4	3	0	2	58

The fact that there were four persons per family at home for the farms included in this study does not mean that the labor force available for farm work was this large. When the ages of the children were considered along with the fact that farm women are not available for full time farm work, the average man equivalent units of labor available was 1.7 for each farm. However, this does not mean that there was actually this amount of work accomplished, but simply that there was this amount of labor available to do farm work.

White owners had an average of 1.6 man equivalent units of family labor available and the white renters and sharecroppers had a slightly larger amount of labor available. (See table 11). In the negro group, the owner families had an average of 1.8 man equivalent units of family labor available while the renter and sharecropper groups had somewhat less than this amount. The differences between any of the tenure groups are not very large, the greatest difference being between the two renter groups. The greatest difference between any of the other groups is only 0.2 of one man equivalent. This means a difference of one full time man for 2.4 months per year. These averages indicate that the labor force available in each of the race and tenure groups is about the same. In other words, each group has approximately the same amount of labor available to combine with the other factors of production.

Table 11. Man equivalent units of family labor available by race and tenure groups, sample farms, Mississippi, 1942

Tenure groups	Number	Man equivalent units of family labor available
		Whites
Owners	131	1.6
Renters	23	1.9
Croppers	29	1.7
		Negroes
Owners	54	1.8
Renters	14	1.3
Croppers	58	1.6

Only a small number of the heads of families included in this study had as much as a high school education. (See table 12). Among the 129 white owners, 27 had one or two years of high school training while 15 completed three or four years of high school education. Three of the white owners completed one or two years of college work; none were college graduates. Five of the owners did not attend school at all, while all of the others had from one to eight grades of grammar

Table 12. Distribution of farmers by education in school, and by race and tenure status, sample farms, Mississippi, 1942

Tenure	Race	Grammar School					High school		College		Total farmers
		Grades completed					Grades completed		Years completed		
		0	1 or 2	3 or 4	5 or 6	7 or 8	1 or 2	3 or 4	1 or 4	3 or more	
		Number of farmers									
Owners	White	5	1	13	19	46	27	15	3	0	129
Owners	Negro	5	2	9	17	16	4	0	0	0	53
Owners	Total	10	3	22	36	62	31	15	3	0	182
Renters	White	1	0	4	6	8	2	2	0	1	24
Renters	Negro	1	1	4	3	6	0	0	0	0	15
Renters	Total	2	1	8	9	14	2	2	0	1	39
Croppers	White	1	1	3	5	12	5	2	0	0	29
Croppers	Negro	9	3	14	18	8	0	2	1	0	55
Croppers	Total	10	4	17	23	20	5	4	1	0	84
Total	White	7	2	20	30	66	34	19	3	1	182
Total	Negro	15	6	27	38	30	4	2	1	0	123
Grand total		22	8	47	68	96	38	21	4	1	305

school work. The average white owner completed slightly under eight grades of school.

Only four of the negro owners had any high school work and none of these went further than the second year. All the other negro owners had from one to eight years of grammar school work, except five that did not attend school. The average negro owner completed 5.4 grades of school.

In the renter and cropper groups, for both whites and negroes, only a small number attended high school and but two were able to attend college. The proportion attending high school in these groups was greater for the whites than for the negroes. In the negro sharecropper group, 44 of a total of 55 did not get beyond the sixth grade. The average for the negro sharecropper group was 4.5 grades completed. The average negro owner had a little better education than the negro sharecropper, the average for this group being 5.4 grades completed. White owners also had a better education than white sharecroppers. When compared by race, the average white farm operator had better educational opportunities than the average negro operator. The white operators completed about 8 grades of school work while the negro operator completed only 5 grades.

Farm owners and renters for both white and negro races are older than sharecroppers. (See table 13). Twenty of the 29 white sharecroppers were under 40 years of age while only one was over 60. Negro sharecroppers averaged a little older than the white sharecroppers but they were considerably younger than the negro owners.

Table 13. Distribution of farmers by age of head, and by tenure status and race, sample farms, Mississippi, 1942

Age of head (years)	Owners		Renters		Croppers	
	White	Negro	White	Negro	White	Negro
Under 30	12	0	6	2	10	10
30 - 39	26	8	4	7	10	19
40 - 49	29	15	6	3	5	10
50 - 59	38	15	3	1	3	9
60 and over	29	20	5	3	1	9
Total	134	58	24	16	29	57

Few of the negro owners could be considered young men while a fairly large number of white owners were under 40 years of age. This indicates that it is easier for white farmers to move out of the sharecropper group at a comparative earlier age than it is for negro farmers. Perhaps one of the major contributing factors to the ownership of farms by white operators at an early age is the inheritance of property by these younger operators. In the sample studied, 12 white farmers under 30 years of age owned their farms and a total of 38 farmers under 40 years of age were owners.

In the negro group, there was not a single owner under 30 and only 8 owners under 40 years of age. Apparently inheritance and other factors were not working to make owners among the negroes to the same degree as for the white farm operators. The fact that negroes who own farms acquire them so late in life makes it almost impossible for the children, especially the older ones, to inherit the property at an early age.

Over half of the owners, both negro and white, had been on their present farms for more than 10 years. (See table 14). The duration of occupancy on the present farm was similar for both white and negro owners. Twenty percent of the white owners had been on their present farm 3 years or less, while only 12 percent of the negroes had been on their farms for this period.

Table 14. Distribution of farm operators by years on present farm, and by tenure status and race, sample farms, Mississippi, 1942

Years on present farm	Owners		Renters		Croppers	
	White	Negro	White	Negro	White	Negro
Less than 1	9	4	7	3	19	18
1	4	1	5	2	5	11
2	7	2	2	1	2	8
3	7	----	2	2	----	1
4	9	5	2	1	1	4
5	6	1	----	----	----	3
6 or 7	10	3	2	----	----	7
8 or 9	5	6	1	2	1	1
10 - 14	15	9	2	2	1	3
15 - 19	27	6	1	1	----	1
20 - 24	11	6	----	----	----	1
25 - 29	7	7	----	1	----	----
30 and over	18	8	----	1	----	----
Total	135	58	24	16	29	58

In the sharecropper group, 65.5 percent of the white croppers had been on their present farms less than 1 year and 90 percent had been on their present farms 2 years or less. Consequently, only 10 percent of the white croppers had been on their present farms as long as 3 years. For the negro sharecropper, 31 percent had been on their present farms less than 1 year and 64 percent less than 2 years. Thirty-six percent of the negro sharecroppers had been on the same farm for more than 3 years.

These figures show that white sharecroppers move more frequently than negro sharecroppers. This is emphasized by the fact that almost two-thirds of the white sharecroppers had occupied their present farms less than one year, while among the negro sharecroppers, less than one-third had been on their present farm less than a year. This fact may help explain why many landlords show a preference for negro sharecroppers. There seems to be a great deal of unrest and dissatisfaction among white sharecroppers that causes them to move almost every year. It may be that this unrest and dissatisfaction with their sharecropper status is one of the major factors causing the white croppers to move into the owner group much faster than negroes. On the other hand, the willingness of the negro to accept supervision together with his apparent satisfaction in a sharecropper status, ordinarily makes him a good risk as a cropper.

Many negroes seem to prefer to work as sharecroppers on larger farms where they have the advantage of farming good land as well as have the supervision of a competent landlord. By temperament and by tradition, the negro seems to be much better suited for this type of arrangement than the white farmer. As the usual thing, the white operator resents having to be supervised by anyone else and in addition, there is the feeling that the sharecropper status is the domain of the negro and that whites should not be lowered to this status. No doubt this feeling accounts in large part for the unrest and dissatisfaction among the white cropper group. This is not to say that there are no negroes with sufficient ambition and ability to want to become independent owners. In fact, as will be shown, some negroes do become owners, but on the other hand, some others remain sharecroppers their entire lives.

Of the 58 negro owners studied in 1942, only 34 were owners in 1932 or 10 years earlier. (See table 15). The other 24 had entered the owner group from other tenure classifications during this 10-year period. In 1932 three were part owners, six were renters, nine were croppers and the other six were either in non-farm occupations or they had not entered farming because they were too young. Thus it appears that during this period some of the negroes from all tenure classifications were moving upward along the agricultural ladder. On the other side of the picture, half of the negroes that were sharecroppers in 1932 were still sharecroppers in 1942. Nearly all of the other sharecroppers had come in from non-farming occupations or were young persons who entered farming during this period. Only one negro had moved from the owner status to the sharecropper class, while three had moved from the renter class to the sharecropper class.

Table 15. Comparison of tenure status of head in 1932 and 1942, by race, sample area, Mississippi, 1942

Tenure status of head in 1932	Owners		Renters		Croppers	
	White	Negro	White	Negro	White	Negro
Owner	77	34	2	----	2	1
Part owner	9	3	----	----	----	----
Renter	13	6	7	6	2	3
Cropper	10	9	6	3	7	29
Non-farm	5	5	1	1	1	1
None	15	----	7	3	13	12
Farming, tenure status known	1	----	----	1	----	----
Unknown	3	1	1	1	4	9
Total	133	58	24	15	29	56

On the other hand, out of 29 white farmers that were sharecroppers in 1942, only 7 or about one-fourth were croppers in 1932. Two white owners and two renters had moved downward to the sharecropper class during this period. Almost all of the other white croppers had no tenure status in 1932 which means they were young persons who had begun farming during this period.

Among the 133 white farmers who were owners in 1942, 77 were owners in 1932. During this period, 9 part owners, 13 renters, 10 croppers, 5 from non-farming occupations, and 15 with no farming status in 1932 had become owners. Here again is a definite indication that it was possible for a number of farmers in all tenure classes to climb the agricultural ladder. Even in the small groups of renters for both negro and white farmers, there is a definite indication that most of these operators had moved into the renter class from lower tenure classifications during this period.

Physical Resources

The well-being of any group of people depends to a very large extent upon the amount of physical resources available for their use and the way they use these resources. The most important resource used by farmers is the land they cultivate. Half of the white owners included in this study had less than 40 acres of land in cultivation and a total of three-fourths of these farmers had less than 60 acres in cultivation. (See table 16). Only about nine percent of the white owner farms had more than 100 acres in cultivation. In the negro owner group, 51 percent had less than 40 acres in cultivation, while 81 percent had less than 60 acres. Eighty-seven percent of the operators in the renter and sharecropper group both white and negro had less than 40 acres of land in cultivation. In the negro sharecropper group, 22 out of a total of 57 had less than 20 acres of land on which to make a living.

Table 16. Distribution of farmers by acres in cultivation (including open pasture), by tenure and by race, sample farms, Mississippi, 1942

Class by acres in cultivation	Owners		Renters		Croppers		Total	
	White	Negro	White	Negro	White	Negro	White	Negro
	Number of farmers							
Less than 20	18	12	3	3	7	22	28	37
20 - 39	50	18	16	11	19	27	85	56
40 - 59	34	17	4	1	2	7	40	25
60 - 79	10	7	0	0	1	1	11	8
80 - 99	11	2	1	0	0	0	12	2
100 - 139	8	1	0	0	0	0	8	1
140 and over	4	1	0	0	0	0	4	1
Total	135	58	24	15	29	57	188	130

When classified on the basis of the total acres in the farm, the distribution shows that many farms have considerable land that is not in cultivation. (See table 17). This applies particularly to the owner farms. The land resources available should be given serious consideration in any plan which is designed to improve the well being of

Table 17. Distribution of farmers by acres in farm, and by race and tenure[1], sample farms, Mississippi, 1942

Class by acres in farms	Owners		Renters		Croppers		Total	
	White	Negro	White	Negro	White	Negro	White	Negro
Less than 20	2	3	0	2	1	17	3	22
20 - 39	11	8	8	5	17	29	36	42
40 - 59	26	11	4	5	6	7	36	23
60 - 79	21	9	4	2	3	2	28	13
80 - 99	19	10	6	1	1	1	26	12
100 - 139	18	10	1	1	0	1	19	12
140 - 199	21	6	0	0	0	0	21	6
200 - 299	8	1	1	0	1	0	10	1
300 and over	9	0	0	0	0	0	9	0
Total	135	58	24	16	29	57	188	131

[1] The acreage of one negro cropper was unknown. He was omitted.

the farm people in this area. The distribution of the additional land is shown in table 18.

Table 18. Acres in farm, cropland, pasture and woods, by acres in cropland and by tenure groups, sample farms Marion and Jefferson Davis Counties, Mississippi, 1942

Acres in cropland	No. of farms	Acres per farm	Acres crop-land	Open pasture non-crop-land	Woods not pastured	Woods past-ured	Farm-stead & waste
			White owners with croppers				
Less than 20	4	50.0	14.0	2.5	22.0	11.5	1.8
20 - 39.9	9	84.4	35.3	4.7	12.4	30.3	1.7
40 - 79.9	20	167.5	61.8	8.9	58.0	37.7	3.5
80 and over	14	342.8	119.2	17.4	40.4	161.4	4.4
Total or average	47	193.8	69.8	10.1	40.9	70.9	3.3
			Negro owners with croppers				
Less than 20	0	-----	-----	-----	-----	---	---
20 - 39.9	1	40.0	34.0	-----	.2	9.0	1.0
40 - 79.9	12	115.0	54.4	5.4	34.5	17.4	2.9
80 and over	2	195.0	97.5	5.0	39.0	48.0	5.0
Total or average	15	120.7	58.8	5.0	32.9	20.9	3.1
			White owner family farms				
Less than 20	23	48.2	15.2	5.2	17.6	9.6	1.3
20 - 39.9	39	76.1	29.1	2.2	11.1	30.9	1.8
40 - 79.9	21	135.7	50.2	5.1	27.6	45.1	5.3
80 and over	1	160.0	112.0	15.0	28.0		20.0
Total or average	84	84.4	31.5	3.9	17.2	28.2	2.8
			Negro owner family farms				
Less than 20	16	27.5	13.8	1.6	3.6	7.4	1.3
20 - 39.9	14	63.6	30.1	3.2	19.4	8.4	3.8
40 - 79.9	10	90.0	52.4	1.8	7.9	24.9	2.9
80 and over	0	-----	-----	-----	-----	-----	-----
Total or average	40	55.8	29.2	2.2	10.2	12.1	2.6
			White croppers				
Less than 20	10	29.2	15.9	1.0	---	11.0	1.2
20 - 39.9	16	36.2	27.7	.9	---	6.3	.8
40 - 79.9	3	140.0	44.3	7.0	.3	84.0	1.7
80 and over	0	-----	-----	-----	---	---	---
Total or average	29	44.6	25.5	1.6	.3	16.0	1.0
			Negro croppers				
Less than 20	25	18.0	15.7	.8	---	.7	.6
20 - 39.9	26	33.5	27.6	.4	.3	3.3	.7
40 - 79.9	7	67.1	50.1	1.7	10.0	4.0	1.5
80 and over	0	-----	-----	-----	---	---	-----
Total or average	58	30.9	25.2	.7	1.3	2.3	.8

As would be expected, the largest amount of extra land available is on the larger owner operated farms. The 47 farms that were operated by white owners with croppers had an average of about 111 acres of land in woods. These same farms had an average of 70 acres in cultivation. The 14 farms operated by white owners with croppers that had the largest number of acres in cultivation had an average of 119 acres of crop land. There were 15 negro owners that had croppers. These 15 farms averaged 59 acres of cropland and about 53 acres of land in woods. The two largest negro owned farms had an average of 98 acres of land in cultivation. These owner farms, both white and negro, that were operated with croppers were the largest farms included in the sample. Within these two groups, the farms that had the largest acreage in cropland also had the largest acreage in open and woods pasture as well as woods not pastured.

The largest single group in this distribution was the white owner family farms. There were 84 farms in this group and they had an average of 31.5 acres of cropland. In addition to the land in cutivation, these farms had an average of 28 acres in woods that were pastured and 17 acres in woods that were not pasture. There was an average of 4 acres of open pasture on each of these farms.

The negro owner family farms had 29 acres of cropland and, in addition, 22 acres of woods. These negro owner family farms had only 2.2 acres of open pasture. White croppers had an average of 25.5 acres in cropland, 16 acres in woods that were pastured and 1.6 acres of open pasture. The 58 negro sharecroppers had 25 acres of cropland, 2.3 acres of woods pastured, 1.3 acres of woods not pastured, and only 0.7 of an acre in pasture. This table bears out the statement made earlier that, for the most part, croppers have very little land at their disposal other than that which is used for the production of row crops. When all groups of owners and croppers are combined, 66 percent or about two-thirds of these farm operators have less than 40 acres of cropland. About 27 percent have between 40 and 80 acres of cropland and only 7 percent over 80 acres of land in cultivation.

Sharecroppers, renters and one-family farm owners have about 6 acres of cropland per person at home. (See table 19). The cropland per person in the owner groups includes only the members of the owner families and not those of the sharecropper families that are also living on the land. Consequently, the average of 10.7 acres of cropland per person at home in the white owner families and 8.8 acres per person for the negro owner families would be reduced if all the persons who are dependent on the land for a living were included. Indications are that the ratio of people to cropland in this area is about 1 to 6. In other words, there are about 6 acres of cropland for each person on farms in the area. This compares with a 1940 ratio of 1 to 5 for the State of Mississippi and 1 to 10.5 for the United States. The average farm person in Mississippi and the area studied has only about one-half as many crop acres from which to make his farm income as the average farm person in the United States. When compared with certain states the disadvantage for Mississippi farmers is even greater. For example, in 1940, the ratio in Illinois

Table 19. Average number of persons at home, average acres of cropland per person, by race and tenure groups, sample farms, Mississippi, 1942

Tenure status	Average number of persons at home	Acres in cropland average	Cropland per person
		Whites	
Owners	4.2	45.3	10.7
Renters	4.8	28.9	6.1
Croppers	4.8	25.5	5.4
		Negroes	
Owners	4.3	37.3	8.8
Renters	4.0	25.1	6.3
Croppers	4.0	25.2	6.2

was 1 to 18.7 and in Iowa it was 1 to 21.6. In other words, the average farm person in these states had access to from three to four times as much cropland as the average farm person in the Longleaf Pine area of Mississippi.

Another factor that is of importance in determining the production and income of any group of farm people is the amount and quality of equipment and machinery used. In 1942, 38 percent of the white farm owners had less than $100 worth of farm implements and machinery and about 60 percent had less than $150 invested in equipment. (See table 20). Only 7 out of 135 white owners had as much as $500 worth of farm machinery and equipment. None of the negroes had as much as $500 invested in equipment and three-fourths of them had less than $150 worth. Nearly all of the renters had less than $150 invested in implements and machinery and all of the sharecroppers had less than $50 worth of equipment. For the sharecroppers, this means the amount of equipment they owned themselves.

Table 20. Distribution of farms by value of farm implements and machinery owned, and by tenure status and race, sample farms, Mississippi, 1942

Class by value of equipment owned	Owners		Renters		Croppers		Total		All farmers
	White	Negro	White	Negro	White	Negro	White	Negro	
Dollars	Number of farmers								
Less than 50	30	21	14	11	29	58	73	90	163
50 - 99	22	11	5	4	0	0	27	15	42
100 - 149	28	10	2	1	0	0	30	11	41
150 - 199	14	5	1	0	0	0	15	5	20
200 - 299	21	8	0	0	0	0	21	8	29
300 - 499	13	2	1	0	0	0	14	2	16
500 - 799	5	0	0	0	0	0	5	0	5
800 and over	2	0	1	0	0	0	3	0	3
Total	135	57	24	16	29	58	188	131	319

The sharecropper system provides that the landlord furnish the necessary machinery and equipment for the use of the sharecropper. Under these conditions, it is not necessary for them to own a great deal of equipment.

The size and type of machinery and equipment available determines to a very large extent the total amount that a farmer can produce. For the most part farmers in the Longleaf Pine area used half-row equipment. (See table 21). This is true for the smaller one-family farms as well as for the larger farms that have two or more families. Only three tractors were found on the 327 farms studied. The main items of equipment used in the production of crops were turning plows, middlebusters, straight or Georgia stocks, some kind of harrow and a planter. Practically all of these were one-horse items of the type that has been in use since the area was settled. The larger farms with two or more families used the same type of equipment in the production of crops as the smaller farms. Apparently the usual practice is to add another compliment of one-horse equipment to the farm as it becomes large enough for the addition of another unit. Therefore, where tenants are kept, the landlord furnishes each tenant with the one-horse equipment necessary to handle

Table 21. Kind, amount and value of farm machinery and equipment on various farm units, sample farms, Mississippi, 1942

Items of equipment	One family farms						Farms with two or more families					
	79 white			26 negro			37 white			13 negro		
	Number having	Percent having	Average value	Number having	Percent having	Average value	Number having	Percent having	Average value	Number having	Percent having	Average value
Automobile	17	22	$213.38	5	19	$93.00	9	24	$343.88	1	8	$100.00
Pick-up truck	6	8	366.66	----	----	....	2	5	250.00	1	8	350.00
Truck, other	1	1	100.00	----	----	....	11	30	509.09	2	15	575.00
Tractor	1	1	600.00	----	----	....	2	5	275.00	----	----	....
Wagon	45	57	47.38	14	54	62.50	30	81	42.33	10	77	45.50
Turning plows	75	95	6.78	24	92	6.99	36	97	7.76	12	92	5.33
Middlebuster	53	67	9.34	18	65	9.78	33	89	9.87	13	100	10.33
Straight stock	71	90	2.36	23	88	2.35	35	95	2.42	10	77	2.94
Section harrow	8	10	11.80	4	15	4.20	7	19	8.86	2	15	3.00
Gee whiz harrow	27	34	4.54	2	7	4.00	17	46	4.28	3	23	3.88
Other harrow	53	67	4.60	21	81	5.30	23	62	6.07	8	62	4.71
Disk	16	20	23.73	1	3	25.00	9	24	48.00	2	15	15.00
Planter	55	70	13.39	10	38	11.20	31	84	13.23	12	92	13.91
Cultivator	6	7	29.83	1	3	7.50	3	8	63.33	2	15	61.50
Fertilizer distributor	11	14	6.23	----	----	....	10	27	6.04	2	15	3.50
Stalk cutter	12	16	20.27	----	----	....	12	32	40.31	2	15	17.50
Mower	10	13	47.00	1	3	44.00	20	54	55.76	1	8	25.00
Hay rake	7	9	17.14	----	----	....	15	40	19.92	----	----	....
Hay press	----	----	----	----	----	....	2	5	67.50	----	----	....
Cane mill	10	13	34.32	2	7	41.50	6	16	22.60	3	23	52.50
Farm and blacksmith shop	9	11	23.00	----	----	....	8	22	23.13	1	8	15.00
Average value per farm	----	----	187.97	----	----	98.44	----	----	479.80	----	----	249.65

the land he is to operate. From the standpoint of power and equipment used in production, the tenant operated farms are in reality two or more one-horse farms operated under one management.

A larger percentage of farms with tenants had cars, trucks, wagons, fertilizer distributors, stalk cutters and haying equipment than the smaller one-family farms. The major advantage of the tenant operated farms as compared to the smaller owner operated farms seemed to be that a larger percentage of them had these larger items of equipment. For example, 54 percent of the white operators who had tenants and mowing machines and 40 percent had hay rakes while only 13 percent of the one-family white operators had mowers and only 9 percent had hay rakes.

The 26 negroes who owned one-family farms had an average of $98 invested in all farm machinery and equipment. The items most commonly found on these farms were a wagon, a turning plow, a middlebuster, a straight stock, and a harrow. Only 38 percent had a planter and only 3 percent had a cultivator. Usually only one piece of each item of equipment was found and these were almost always the one-horse half-row type.

The 79 white one-family farms had an average of $188 worth of farm machinery and equipment. These farms had the same items as listed above for negro farms and in addition, a few had a disk, a planter, a stalk cutter, a fertilizer distributor and a mower. One farmer out of the 79 had a tractor while 30 percent had some type of truck or automobile. Six farmers out of this group had cultivators that were valued at $30 each which suggests that they are two-horse cultivators of the one-row type. All the other equipment is the single-horse half-row type found generally throughout the area.

There were 13 negro farm owners in the group studied that had one or more tenants. These owners with tenants had $250 invested in farm machinery and equipment. Thirty-one percent of this group had a car or truck, but none had a tractor. For the most common items of equipment, the only difference between these and the one-family farms is that the farms with tenants have two or more sets of one-horse equipment. Two of these negro operators had cutivators, two had fertilizer distributors and two had stalk cutters.

The 37 white operators that had tenants had $480 invested in farm machinery and equipment. Around 60 percent of these operators had either a truck or an automobile, but only two had tractors. The usual items of equipment were the same in this group as for the others, the only difference being that there was a set of equipment for each tenant. In addition to this regular equipment, at least a fourth of these operators had fertilizer distributors, stalk cutters, mowing machines and hay rakes.

The total value of the farm business[1] is another index of the amount of resources available for each family. In 1942, 56 percent of the white owner farms had a total farm business valuation of less than $3,000. (See table 22). In the negro owner group, 68 percent had a total farm business of less than $3,000. Only two of the renters and sharecropper operators had a farm business valued at more than

$3,000. The lowest valuation was found in the negro sharecropper group where all except three had a total farm business valuation of less than $1,500.

Table 22. **Distribution of farmers by 1942 valuation of total farm business by race and by tenure status, sample farms, Mississippi, 1942**

Value of farm business	Owners		Renters		Croppers		Total	
	White	Negro	White	Negro	White	Negro	White	Negro
Dollar	Number of farmers							
Less than 500	0	7	2	0	3	15	5	22
500 - 999	11	4	6	8	14	25	31	37
1000 - 1499	19	7	2	2	6	14	27	23
1500 - 1999	14	8	6	3	2	2	22	13
2000 - 2999	30	11	8	1	1	1	39	13
3000 - 3999	22	8	0	0	1	0	23	8
4000 - 6999	26	7	0	0	1	0	27	7
7000 - 11999	7	2	0	0	0	0	7	2
12000 and over	3	0	0	0	0	0	3	0
Total	132	54	24	14	28	57	184	125

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[1] The value of farm business is the value of the real estate used plus the ending inventory value of livestock and equipment.

When grouped on the basis of the 1942 valuation of the farms occupied, 73 percent of the white owner farms were valued at less than $3,000 while 81 percent of the farms occupied by negro owners had a valuation less than this amount. (See table 23). All farms occupied by negro sharecroppers had a valuation of less than $2,000 and nearly all farms occupied by white sharecroppers fell in this same group. It is readily seen from these data that the value of the farm occupied as well as the total value of the farm business was low for all groups of farms, both white and negro.

Table 23. **Distribution of farmers by 1942 valuation of farm occupied, and by tenure status and race, sample farms, Mississippi, 1942**

Value of Farm	Owners		Renters		Croppers		Total	
	White	Negro	White	Negro	White	Negro	White	Negro
Dollar	Number of farmers							
Less than 1000	19	16	9	9	19	44	47	69
1000 - 1999	44	19	11	5	7	13	62	37
2000 - 2999	33	8	4	0	1	0	38	8
3000 - 4999	25	7	0	0	1	0	26	7
5000 and over	11	3	0	0	1	0	12	3
Total	132	53	24	14	29	57	185	124

The value of livestock owned, including workstock, was higher for the white owner farms than for any other group. (See table 24). About 62 percent of the white owners had over $400 worth of livestock per farm. This means of course, that about 38 percent of the white owners had less than $400 invested in livestock, including workstock. On the other hand, 38 percent of the negro owners had over $400 worth of livestock while 62 percent had less than this amount. In the sharecropper groups for both white and negro, all had less than $200 invested in livestock. When the value of workstock is

Table 24. Distribution of farmers by value of livestock owned, and by tenure status and race, sample farms, Mississippi, 1942

Class by value of livestock owned	Owners		Renters		Croppers		Total		All farmers
	White	Negro	White	Negro	White	Negro	White	Negro	
Dollars	Number of farmers								
Less than 100	2	12	2	3	18	46	22	61	83
100 - 199	11	5	8	6	8	10	27	21	48
200 - 399	38	19	6	5	2	2	46	26	72
400 - 599	31	12	6	2	0	0	37	14	51
600 - 999	32	6	2	0	0	0	34	6	40
1000 and over	20	4	0	0	0	0	20	4	24
Total	134	58	24	16	28	58	186	132	318

removed from the tabulation, it is shown that practically all productive livestock is found on the owner operated farms. (See table 25). In the negro sharecropper group, 48 out of a total of 58 had less than $100 worth of productive livestock. Only one farm in this group had over $200 invested in livestock. The situation is practically the same for white sharecroppers. Some of the renters in both white and negro groups had a little productive livestock but not as much as is found in the owner group. This situation bears out an observation made earlier in this report that it is very difficult under the present tenure system for sharecroppers to handle any large amount of productive livestock. The fact that they have only 30 to 40 acres of land at their disposal makes it imperative that they use practically all of it in cultivated crops. It is almost impossible to establish successful livestock enterprises on small farms such as those found in this area. This applies to nearly all sharecroppers and renters and to a large proportion of the farm owners in both negro and white groups.

Table 25. Distribution of farmers by value of livestock, other than workstock owned, and by tenure status and race, sample farms, Mississippi, 1942

Value Class	Owners		Renters		Croppers		Total		All farmers
	White	Negro	White	Negro	White	Negro	White	Negro	
Dollars	Number of farmers								
Less than 50	4	9	6	5	12	37	22	51	73
50 - 99	16	10	5	5	9	11	30	26	56
100 - 149	10	8	4	4	4	8	18	20	38
150 - 199	23	11	3	0	1	1	27	12	39
200 - 249	20	9	0	1	0	0	20	10	30
250 - 299	11	6	1	0	2	0	14	6	20
300 - 399	16	2	1	1	0	1	17	4	21
400 - 599	13	1	4	0	0	0	17	1	18
600 - 999	14	2	0	0	0	0	14	2	16
1000 and over	7	0	0	0	0	0	7	0	7
Total	134	58	24	16	28	58	186	132	318

Use of Land Resources

The major proportion of the cropland is devoted to the production of cotton and feed-grain crops on all farms studied in this area. (See able 26). The 47 white farmers who had croppers, planed on the average about 18 acres in cotton. Within this group, the acres planted in cotton ranged from 4.5 for those farms with less than 20 acres of cropland to 29 acres for the farms with over 80 acres of cropland. These same farms had an average of 32.5 acres in feed-grain crops. These larger farms had an average of 5 acres in garden and truck crops and 7 acres in hay and forage crops. In every case, the larger farms in the group had the largest average acreage for each crop or group of crops.

Negro owners that used sharecroppers had an average of 16 acres of cotton and 28 acres of feed-grain crops. These negro owners also devoted some of their cropland acres to truck and garden crops, hay and forage crops, and annual rotation pasture. The average acreage devoted to each of these was a little smaller than for the white owners who had sharecroppers.

White owner family farms had an average of 8 acres in cotton and

Table 26. Acres planted to various crops on farms grouped by acres in cropland and by tenure groups, sample farms, Marion and Jefferson Davis Counties, Mississippi, 1942

Acres in cropland	Number of farms	Acres in cotton	Acres in peanuts	Garden truck acres	Feed-grain acres	Hay-forage acres	Annual rotation pasture	Idle crop-land
				White owners with croppers				
Less than 20	4	4.5		2.7	5.3	.5	3.3	----
20 - 39.9	9	9.1	.6	2.1	1.9	2.1	3.3	1.8
40 - 79.9	20	16.4	1.7	5.4	26.4	5.6	4.5	3.2
80 and over	14	29.1	2.0	6.7	57.8	13.5	16.0	4.2
Total or average	47	17.8	1.5	4.9	32.5	6.9	7.6	2.9
				Negro owners with croppers				
Less than 20		----	—	—	—	—	—	—
20 - 39.9	1	10.0	1.0	3.7	12.0	1.0	7.0	..
40 - 79.9	12	15.2	1.4	3.6	26.0	4.4	5.9	3.3
80 and over	2	26.5	2.0	4.9	45.0	2.5	11.5	4.5
Total or average	15	16.4	1.5	3.7	27.6	3.9	6.7	3.3
				White owner family farms				
Less than 20	23	3.8	.6	1.6	6.7	6.9	3.3	.7
20 - 39.9	39	7.7	.7	2.7	12.5	2.1	5.3	1.7
40 - 79.9	21	11.9	1.1	3.9	19.4	4.7	7.5	6.0
80 and over	1	33.0	3.0	4.0	40.0	22.0	6.0	3.0
Total or average	84	8.0	.8	2.7	13.0	2.6	5.3	2.5
				Negro Owner family farms				
Less than 20	16	5.3	.6	1.6	6.4	1.3	2.3	1.1
20 - 39.9	14	8.7	.9	2.6	12.9	1.9	1.5	2.8
40 - 79.9	10	13.7	1.6	3.2	26.1	3.6	7.9	2.1
80 and over	0	----	.	----	----	..	----	----
Total or average	40	7.8	.9	2.4	13.6	2.1	3.4	1.9
				White croppers				
Less than 20	10	6.2	.5	1.3	8.0	.1	.8	..
20 - 39.9	16	8.9	.5	1.9	15.0	.1	2.7	.5
40 - 79.9	3	14.0	1.7	3.4	25.0	.	6.0	----
80 and over	0	----	----	----	----	----	----	----
Total or average	29	8.5	.6	1.9	13.6	.1	2.4	.3
				Negro croppers				
Less than 20	25	6.1	.5	1.3	7.0		1.1	.2
20 - 39.9	26	9.5	.6	1.6	14.0	.2	1.5	.7
40 - 79.9	7	16.8	.8	3.2	28.0	.1	9.0	----
80 and over	0	----	----	----	----		----	----
Total or average	58	8.9	.6	1.6	13.0	.1	2.2	.1

13 acres in feed-grain crops. As was the case with the other groups, the larger the amount of cropland available, the larger was the acreage devoted to garden and truck crops.

Negro owner family farms had an average of 7.8 acres of cotton and 13.6 acres in feed-grain crops. This was almost the same acreage devoted to these crops as was planted to the same crops on the white owner family farms. The negro owners in this group also planted small acreages to garden-truck and hay-forage crops. For both the white and negro sharecropper groups, the acreages planted to cotton and feed-grain crops were very nearly the same. It is interesting to note also that the acreages planted to these crops by croppers were almost the same as for the owners in both the white and negro family groups. In other words, as far as the major crops are concerned, the sharecroppers have the same acreage from which to draw an income as the owners of family farms. The sharecroppers have very little acreage devoted to hay-forage crops and only a small amount planted to garden-truck crops.

The only difference between the crop organization of the sharecropper farms and the small owner farms is the slightly larger amount of land planted to garden-truck, hay-forage, and annual rotation pasture on the small owner farms. These additional acreages probably make it possible for these small owners to produce sufficient vegetables, meat, milk and poultry products for their own use while on the cropper farms the acreage is hardly sufficient for this purpose.

On both the small owner and sharecropper farms, the acreage planted to feed-grain crops was usually sufficient to produce enough grain to feed the mule necessary to take care of the cotton that was grown. Even though the acreage planted to feed-grain crops is considerably larger than the acreage planted to cotton, feed-grains are not grown commercially, almost the entire production being used to feed the livestock on the farm.

Cotton is the major cash crop on nearly all farms in the area. When classed as to the type of farming, almost all of the renters and croppers have to be classed as cotton farmers. (See table 27). Among the white farm owners, a large majority were classed as cotton farms but 32 of these had sufficient livestock to put them in a cotton-livestock classification. Eight other farms were classed as cotton-truck and 12 were classed as general farms. There were only four negro owners that were classed as cotton-livestock farmers. Three

Table 27. Type of farming, by tenure and race groups, sample farms, Mississippi, 1942

Tenure status	Cotton	Cotton-livestock	Cotton-truck	General	Incidental or subsistence	None
				White		
Owners	75	32	8	12	4	0
Renters	21	0	0	2	0	0
Croppers	28	1	0	0	0	0
				Negro		
Owners	38	4	3	4	6	0
Renters	14	0	0	0	0	0
Croppers	54	0	4	0	0	0

had sufficient truck crops to place them in the cotton-truck classification and four were classed as general farms. On the basis of these tabulations, the major departure from the straight cotton type of farming was found in the white-owner group and to a lesser extent in the negro-owner group. With very few exceptions, renters and sharecroppers were all in the cotton type of farming classification.

The amount of land resources available apparently has a great influence on the number of productive livestock that can be kept on these farms. White owners, for example, have the largest number of animal units of productive livestock. (See table 28). Many negro owners likewise have some productive livestock, but have not gone into the livestock business to the same extent as many of the white operators. On the other hand, on both the renter and sharecropper farms where land resources are limited, the animal units of livestock are very small. This is particularly true in the negro sharecropper group where 45 out of a total of 56 have one or less units of productive livestock.

Table 28. Animal units of productive livestock, by tenure and race group, sample farms, Mississippi, 1942

Tenure status	.0	.01	1.0	2.0	3.0	4.0	5.0	7.0	11.0	15.0	31.0
						White					
Owners	0	5	15	21	22	11	22	14	8	9	4
Renters	1	3	7	3	5	1	3	0	0	0	0
Croppers	1	5	14	4	1	1	2	0	0	0	0
						Negro					
Owners	1	9	8	12	8	8	5	4	0	0	0
Renters	1	1	8	2	0	2	0	0	0	0	0
Croppers	2	23	22	9	1	0	0	1	0	0	0

It should be said that livestock enterprises are not particularly important in any part of this area and with the limited amount of land resources available to the average farmer, it is not likely that they will become of any great importance until some change is made. At the present time, the only place where livestock enterprises are of any importance is on the larger owner-operated farms. The less than 40 acres of cropland available to at least two-thirds of the farmers in this area is not sufficient to support much more than just enough livestock to provide for home needs.

Use of All Resources

In previous sections of this report, the amount of labor available, the capital investments in the form of machinery and equipment, and the amount of land available have been shown for various sizes of farms for both race and tenure groups. These are the factors of production that each farm operator has to combine on his farm in the production of farm commodities. The amount of income at the end of the year depends not only upon the amounts of these factors available, but the way in which they are combined on the individual farm. The quantity of these factors available together with the way they are combined, are most readily measured by the total amount of income derived from the entire operation. For instance, the gross farm income for the 27 white farm owners with less than 20 acres of cropland averaged $653. (See table 29).

On the other hand, the 9 white sharecroppers that had less than 20 acres in cropland had an average gross farm income of $861. This same relationship exists between the white owners and the white sharecroppers that had between 20 and 30 acres of cropland, because in this group also, the sharecroppers had a slightly larger gross income.

It was not until the group of farms that had between 40 and 80 acres of cropland was reached that the owner farms showed a larger gross income than the sharecropper farms. When compared on the basis of family earnings this same relationship exists. That is, the total family earnings in the sharecropper groups are about equal or larger than for the same size groups of white owners. When an allowance for the unpaid family labor is deducted and the comparison is made on the basis of operator's earnings, a definite advantage for

Table 29. Gross farm income, family earnings, operator's earnings and non-farm income, sample farms in Marion and Jefferson Davis Counties, Mississippi, 1942

Acres in cropland	Number of farms	Gross farm income	Family earnings	Operator's earnings	Non-farm income
			White owners		
Less than 20	27	$ 653	$ 277	$ 156	$ 837
20 - 39.9	48	1089	558	431	384
40 - 79.9	38	1814	695	547	503
80 and over	15	3880	616	470	731
Total or average	128	1539	546	412	556
			Negro owners		
Less than 20	16	389	209	140	240
20 - 39.9	15	833	249	235	386
40 - 79.9	22	1378	612	333	203
80 and over	2	2069	399	91	148
Total or average	55	967	437	242	262
			White renters		
Less than 20	4	412	213	169	337
20 - 39.9	16	886	444	334	305
40 - 79.9	3	1218	673	198	420
80 and over	0	......	...	..	..
Total or average	23	847	433	288	326
			Negro renters		
Less than 20	3	469	223	188	113
20 - 39.9	10	600	327	178	242
40 - 79.9	1	1078	148	—152	366
80 and over	0	......	......	...	
Total or average	14	606	292	180	223
			White croppers		
Less than 20	9	861	388	350	302
20 - 39.9	16	1119	513	340	263
40 - 79.9	7	1779	798	439	92
80 and over	0	.....	.....		.....
Total or average	28	1107	503	354	258
			Negro croppers		
Less than 20	24	707	328	228	166
20 - 39.9	26	1148	515	350	90
40 - 79.9	7	1968	929	703	113
80 and over	0	.....	.....	.....	
Total or average	57	1063	487	342	125

the sharecropper group is shown only for those having less than 20 acres in cultivation. This is a definite reflection of the fact that the sharecroppers have larger families and consequently more unpaid family labor than the owners.

Negro farm owners, on the average, have less gross farm income than negro sharecroppers in all groups except those having over 80 acres of land in cultivation. The advantage in gross farm income in favor of the negro sharecroppers is large enough to offset the additional amount they have to pay out in the form of shares and still give them average family and operators earnings larger than the negro owners. This applies to all negro farms where there are sufficient numbers to make reliable comparisons. When productive man-work-units are used as the size measure, the relationships are the same as when acres in cultivation are used. (See table 30).

Renters in both white and negro groups for all sizes have smaller

Table 30. Gross farm income, family earnings, operator's earnings and non-farm income for various tenure groups and sorted by productive man-work-units, sample of farms in Marion and Jefferson Davis Counties, Mississippi, 1942

Productive man work units	Number of farms	Gross farm income	Family earnings	Operator's earnings	Non-farm income
			White owners		
Under 200	32	$ 553	$ 250	$ 153	$ 707
200 - 299	39	1067	488	361	467
300 - 599	42	1831	759	593	465
600 and over	15	4059	831	589	718
Total or average	128	1540	546	412	556
			Negro owners		
Under 200	20	400	226	148	203
200 - 299	10	802	408	257	397
300 - 599	24	1376	611	316	253
600 and over	2	2069	399	91	148
Total or average	56	950	429	237	257
			White renters		
Under 200	11	519	259	183	338
200 - 299	8	1018	547	395	180
300 - 599	4	1409	686	364	582
600 and over	0	......	......	......	......
Total or average	23	847	433	298	326
			Negro renters		
Under 200	8	533	265	163	202
200 - 299	4	627	359	201	182
300 - 599	2	859	265	115	324
600 and over	0	......	......	......	......
Total or average	14	606	292	180	214
			White croppers		
Under 200	13	845	373	333	246
200 - 299	10	1201	564	372	312
300 - 599	5	1601	721	373	178
600 and over	0	......	......	......	......
Total or average	28	1107	503	354	258
			Negro croppers		
Under 200	31	728	334	225	136
200 - 299	16	1178	525	357	108
300 - 599	10	1919	913	679	115
600 and over	0	......	......	......	......
Total or average	57	1063	489	342	125

incomes than sharecroppers. In fact, renters as a group had a smaller average income than any other tenure group.

It would seem from these figures that for practically all of the negro farm operators and all the small and medium size white farm operators, the sharecroppers have a larger gross as well as net farm income from their operations than the owners or renters in the same group. It can be concluded further that the advantage in favor of farm ownership is not reached until the size of the farm is considerably larger than the average found in this area.

The low income on the small white owner farms was supplemented to a considerable extent by outside non-farm income. The average white farm owner had $556 of non-farm income during 1942. Because of the unusual employment opportunities offered during this year, this is probably larger than would be expected during any normal year. The very small white owners derived somewhat more non-farm income than from their farming operations. It is entirely possible that these unusual opportunities for off-farm employment may have affected the farming operations on these small farms during this particular year.

The neglect of the farm and its operations could have been one of the causes for the fairly low income on some of these farms. However, off-farm employment opportunities were available to the white sharecroppers and they took advantage of these opportunities but not to the same extent as the white owners.

Negro owners had an average of $262 of non-farm income while the negro sharecroppers had only $125 from this source.

The non-farm income for the owner groups is about enough in each case to make up the difference in farm income. However, the fact remains that from a strictly farming standpoint, the sharecropper system provided a larger income for the operators following this system than ownership provided for those families that owned small farms. One possible explanation of this situation may be that sharecroppers as a group probably were on better land than small farmers. In most instances, the larger farm owners in any area will have access to some of the best land in the area and, of course, it is only these larger farms that have sufficient land resources to use sharecroppers.

The higher yields obtained by the sharecropper groups indicate that they were probably on better land than the small owners. (See table 31). The 50-year average cotton yield was 243 pounds of lint for white owners with less than 20 acres and 275 pounds for sharecroppers in the same size group. The crop yield index was 110 for the owners and 125 for the sharecroppers when compared on the same basis as above. In the next size group from 20 to 40 acres of cropland, the cotton yield and the crop yield index for white operators are almost the same for the owners and sharecroppers. It is not until the medium to large owner farms are reached that a distinct advantage in yield is shown for the owner-operated farms. However, there are not enough sharecroppers in these large size groups to make

Table 31. **The relationship between acres in cropland, cotton yield, and crop index, by texture and race, sample farms, Mississippi, 1942**

Acres in cropland	Number of farms	Cotton production 100 pounds	Cotton, 5 yr. average yield pounds	Crop yield index
White owners				
Less than 20	27	12	243	110
20 - 39.9	48	29	261	111
40 - 69.9	41	55	269	113
80 and over	15	126	300	108
Total or average	131	45	264	111
Negro owners				
Less than 20	16	9	159	87
20 - 39.9	15	24	192	77
40 - 69.9	22	42	220	75
80 and over	2	76	268	54
Total or average	55	29	197	78
White renters				
Less than 20	4	9	222	79
20 - 39.9	16	24	222	93
40 - 69.9	3	30	365	112
80 and over	0	----	----	----
Total or average	23	22	227	93
Negro renters				
Less than 20	3	15	257	96
20 - 39.9	10	17	215	58
40 - 69.9	1	55	216	48
80 and over	0	----	----	----
Total or average	14	20	224	66
White croppers				
Less than 20	10	25	275	125
20 - 39.9	16	34	251	113
40 - 69.9	3	46	247	134
80 and over	0	----	----	----
Total or average	29	32	259	119
Negro croppers				
Less than 20	25	24	249	106
20 - 39.9	26	41	311	119
40 - 69.9	7	69	282	88
80 and over	0	----	----	----
Total or average	58	37	281	109

reliable comparisons. The average crop yield index is higher for all white croppers than for all white owners.

The 5-year average cotton yield and the crop index are higher for the negro sharecroppers in all size groups than for negro owners. The 5-year average cotton yield for all negro owners was 197 pounds while for negro sharecroppers it was 281 pounds. The average crop yield index was 78 for negro owners and 109 for negro sharecroppers.

The higher yields obtained by the sharecroppers probably result from better land and the advantage of good management. Farm operators and other landlords that have accumulated enough capital to become large farmers almost always have considerable managerial ability. Sharecroppers on farms owned and operated by these superior managers have a distinct advantage over many of the owners of small farms. Unless a farmer has unusual ability along with considerable determination, it is very difficult for him to accumulate enough capital from the operations of a small farm operated with small, labor consuming equipment to gradually make him a larger farm operator.

About the only chance he has of increasing his farm capital is to supplement his farm income by off-farm employment. As is shown in table 29, many of the white as well as negro farm owners did this during the year studied. It is possible that many small farm operators are able to become larger farm owners in this manner. This applies particularly to the white owner group.

Among the negroes it seems that only a very few have thus far succeded in becoming very large farm owners. In the sample studied, only 2 out of a total of 55 negro owners had over 80 acres of land in cultivation. Observations made by the enumerators indicate that for the most part these negro owners are on poor land, have very inefficient machinery and equipment, and in many instances are poor managers.

As has already been pointed out, these observations are further substantiated by the fact that negro owners in all groups have smaller incomes than negro sharecroppers. It would seem from these facts that it might be a wise policy for farm operators, both negro and white, with limited capital to farm as sharecroppers on large farms with good land and good managerial supervision, until they can accumulate the necessary capital to make an initial payment on at least an average size farm. In many instances, the farm operator's chances of becoming a successful farm owner would be greater if he started in this manner rather than as an owner on a small farm with poor land and poor equipment.

The ideal of farm ownership is not a worthy ideal if it means half starvation and virtual bondage on 20 to 30 acres of poor land with a poor mule and half-row equipment. In many cases, there seems to be considerable evidence that ownership of this type should be placed at the very bottom of the agricultural ladder rather than at the top. In the area studied in Mississippi as well as many other areas in the State and the South, this type of ownership places a man in a position where it is almost impossible for him ever to accumulate enough capital from the operations of the farm itself to make him an independent, successful farm operator. As has been pointed out already, about the only chance he has to accumulate capital is to seek employment off the farm. On the other hand, the operator who succeeds in getting a sharecropper holding on a successful, large farm unit has an opportunity to advance himself along the agricultural ladder and eventually become a successful farm owner.

Conclusions

The average farm family on a small owner-operated farm did not have as much farm income during 1942 as the farm family that operated on a sharecropper basis. This was true for both white and negro farmers but was more pronounced with the latter group. The labor force, the equipment used, the cropping pattern and the land resources averaged about the same in the two tenure groups for both white and colored operators.

The major items of equipment used were very nearly the same for all tenure and race groups. The half-row one-mule type of equipment predominated on all farms. Even the larger farms that were operated by tenants used a set of one-mule equipment for each tenant. Only three tractors were found on the 327 farms included in this study.

Apparently the tenure system along with the cotton type of farming has delayed the introduction of labor-saving machinery and equipment on the larger farms in this area. On the other hand, a large proportion of the owner operated farms are too small for efficient use of the larger types of equipment.

The improvement of farm incomes in this area is limited by the size of many of the farms and the lack of improved equipment both of which have been instrumental in keeping a large farm population in the area in relation to the land resources. The present and potential farm income can be increased by improved practices, better management and other means, but is limited by the burden of people on the land. The general use of improved equipment will depend upon the increase in size of many farms and will result in many changes in the traditional tenure system practiced in the area.

Bulletin 431 June 1946

Problems In Farm Management

And Production Costs

On 40 Farms In Northeast Mississippi

MISSISSIPPI STATE COLLEGE
Agricultural Experiment Station
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Farmers Keeping Records in 1944:

Alcorn County

Frank Conn
Austin O. Miller
Bill Parke

Chickasaw County

David F. Arndt
I. W. Baird
J. C. Baird
Howard Brand
E. F. Brent
E. L. Gann
P. A. Morgan
R. T. Turner

Lee County

G. C. Evans
Elmer Hurt
J. I. Maxey
T. L. Roper
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Noxubee County

Henry Boykin
Eugene Butler
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G. D. Douglass, Jr.
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Johnny Heard
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Farm Management and Costs of Production on 40 Farms in Northeast Mississippi

By W. J. EDENS[1]

This bulletin reports a study, by the cost account method, of 40 dairy and cotton farms in Northeast Mississippi for the calendar year 1944. The purpose of the study was to determine farm costs and farm management practices in their relation to production problems and income, especially on farms producing milk for sale, and with possible recommendations for adjustments. Attention in particular is given to the costs of producing milk and cotton in their relationship to types of farm organization, and profits derived from these major enterprises as well as from minor enterprises and the farm business as a whole. It is hoped that the results of this study will stimulate farmers of the area to give more thought to the organization of their farms and to utilize more efficiently the land, capital, and labor under their management, and will serve as a means of facilitating the agricultural extension program of this State.

Most of the farms in Northeast Mississippi produce cotton and a large number keep milk cows. Cotton has been the principal income crop since the area was first settled. Since the turn of the century, it has been demonstrated that a single row-crop enterprise as the main source of income involves considerable risk and does not give a return to the farm business as a whole comparable to that which is realized when income enterprises are more diversified. Consequently, farmers and various agricultural agencies have been endeavoring to find the best means and methods to be used in providing the most profitable combination of enterprises for farms in each of the naturally defined areas of the State.

Emphasis has been placed on more livestock production as well as improved practices in growing crops. For the past three decades, much attention has been given to dairying as a supplement to cotton production. Agricultural and various business and civic agencies have encouraged the establishment of milk processing plants such as cheese factories, creameries, and condenseries in many communities of the State with most of the larger plants located in Northeast Mississippi. Fifty-seven of these plants have been established since 1912. At present, 31 are in operation with most of the fatalities having occurred among creameries. Nineteen of the 31 plants now in operation are located in the 11 counties constituting the Northeast Mississippi Milkshed Area.[1]

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[1] Professor of Agricultural Economics, Mississippi State College.

With the coming of these plants, the dairy cow population in the respective communities, or patronage areas, increased considerably. Many thought that this step in farm enterprise diversification would solve the one-crop system of farming. It has helped; but the problems have arisen such as low production per cow, unprofitable methods of feeding, high-cost transportation, low production during winter months making it difficult for milk plants to operate efficiently during that period, and dairy cattle diseases, and parasites. While some farmers appeared to be profiting by adding dairying to their business, others appeared to be deriving little benefits from milking cows along with the production of cotton.

Since so many factors—size, rates of production, combination of enterprises, use of labor, farm practices—are responsible for determining the profit made by the farm business, it was thought that if a study were made of representative farms where milk was produced and sold to milk plants so that detailed attention could be given to those factors largely determining profits, much benefit might be derived for both farmers and milk plants.

Location of Farms Studied

Farms selected to cooperate in this study were located in Alcorn, Prentiss, Lee, Chickasaw, and Noxubee Counties, all of which are found in the three major soil areas of Northeast Mississippi, namely, Northeast Highlands, Northeast Prairie, and the Pontotoc Ridge. (See figure 1.) Though the Northeast Prairie Area separates the Northeast Highlands and Pontotoc Ridge Areas, the soils of all three areas are rather distinct.

The Northeast Highland Soil Area developed mostly from coastal plain deposits of sand, clay, and gravel. They are red or yellow wherever the drainage is good, and are generally quite sandy in texture. The rugged topography of parts of the area and poor solid management practices have contributed to severe erosion of the soil on many farms. The commonly occurring soils of the Northeast Highlands are Ruston, Savannah, Cuthbert, Paden, and Ocklocknee. The principal crops grown in this area are cotton, corn, oats, lespedeza, cowpeas, and soybeans. In addition to the field crops, pine timber affords a cash income in several locations.

The soils of the Northeast Prairie are derived from soft, chalky limestone and clays which are coastal plain deposits. Because of the nature of the parent material, the soils possess texture of the clay and heavy clay classes. The topography is gently rolling and sheet erosion has wrought great damage to much farm land. The soils are easily recognized by the dark and red colors, and vegetation of grass and post oak. The dark soils are Houston, Sumpter, and Trinity,

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[1] Development of the Dairy Industry in Mississippi, by D. W. Parvin. Mississippi Agricultural Experiment Station Bulletin 422, July, 1945.

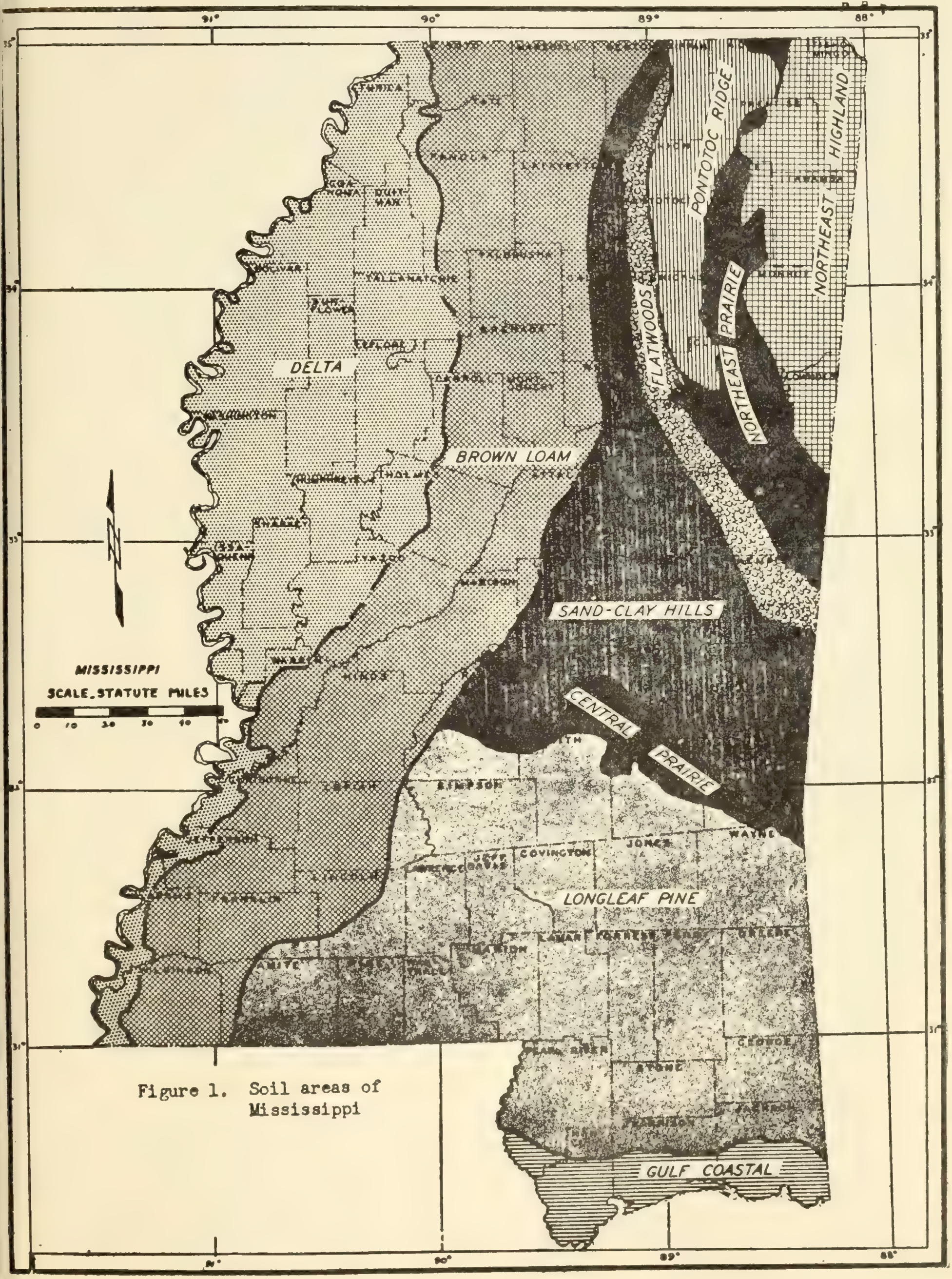
91°
90°
89°
88°
35°
34°
33°
32°
31°
DELTA
BROWN LOAM
FLATWOODS
PONTOTOC RIDGE
NORTHEAST PRAIRIE
NORTHEAST HIGHLAND
SAND-CLAY HILLS
CENTRAL PRAIRIE
LONGLEAF PINE
GULF COASTAL
MISSISSIPPI
SCALE. STATUTE MILES
0 10 20 30 40
TUNICA
PANOLA
LAFAYETTE
COAHOMA
QUITMAN
BOLIVAR
TALLAHATCHIE
YALOBUSHA
GRENADA
LEFLORE
CARROLL
WASHINGTON
HOLMES
SHARKEY
ISSAQUENA
YAZOO
MADISON
WARREN
HINDS
SIMPSON
JEFFERSON
LINCOLN
COVINGTON
JONES
WAYNE
JEFF DAVIS
LAMAR
FORREST
PERRY
GREENE
MARION
AMITE
PEARL RIVER
STONE
GEORGE
JACKSON
HARRISON
MONROE

Figure 1. Soil areas of Mississippi

commonly called "Black Prairie", and the red soils are Oktibbeha and Montrose, commonly called "Post Oak Prairie." The crops grown are cotton, corn, oats and silage crops, and much livestock is fed. Johnson grass is well adapted to this area and is used for hay along with soybeans. Dallis grass and white and hop clovers, make excellent pastures in this area and contribute much to the production of livestock.

Soils of the Pontotoc Ridge Area have developed from marine deposits of sands and clays that are reddish in color, and naturally the soils are predominantly reddish in color. The texture varies from a sandy loam to clay. The topography is rolling to rough and rugged. Thus, the soils have suffered severe damage from accelerated erosion where protective measures have not been applied. The main soils are Greenville, Orangeburg, and Ruston, on uplands, and Hannahatchie and Ocklocknee. The principal crops are corn and cotton for row crops; lespedeza, soybeans, and cowpeas for hay. Pine timber also contributes to the income of the farmers.[1]

Method of Selecting Farms

Farms selected for this study were suggested by county agricultural agents, milk plant managers and their field men, county representatives of the Agricultural Adjustment Agency, and local representatives of the Soil Conservation Service. These agricultural leaders were requested by personal interview to suggest farmers who, they thought, were progressive in their farm operations, would be interested in making a study of their farm business, and would be willing to keep the necessary records.

The enterprise organization of each farm was studied by means of the 1944 farm plan sheets made available by the several county AAA officers. Farms were then divided into three groups determined by the emphasis placed on the production of milk and cotton, and farm types were so designated. Farms with a large number of cows compared with the number of acres in cotton comprised one group, or *dairy-cotton* farms. A few farms in this group did not grow cotton after having planned to do so. Where the number of acres of cotton was large in proportion to the number of cows, the farm type was designated *cotton-dairy.* The farms having about the same number of cows as acres of cotton constituted the third type, or *dairy & cotton.* Of the 40 farms keeping records, 16 were dairy-cotton, 12 cotton-dairy, and 12 dairy & cotton. This manner of grouping was selected in order that comparisons could be made relative to cost factors and income for the various farm enterprises under different organizational conditions.

Operators of the farms thus selected were interviewed on their farms where consent was obtained to keep the necessary rcords. The supervision of the keeping of the records was done by a member of the Experiment Station staff, and each farm was visited once every 4 weeks.

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[1] The description of these three soil areas was taken largely from their description as set forth by the Mississippi State Department of Agriculture, 1942.

Description of Farms Studied

Land Utilization

The average amount of land per farm for the 40 farms was 170 acres. Table 1 shows how the total land for all farms as a whole and by types of farms was used. Cropland accounted for 75 acres per farm, or 44 percent of total land. Open, tillable pasture land amounted to 43 acres per farm, representing 25 percent of all land; and open non-tillable pasture land amounted to 21 acres, or 12 percent. Thus, 81 percent of all land was open land. Woods pastured accounted for 8 percent of the land per farm; woods not pastured, 5 percent; and the other land used for miscellaneous purposes, 5 percent. It will be noted that pasture land of all kinds amounted to 88 acres, or slightly more than one-half of the total average acreage per farm.

On farms where cotton was the major enterprise, 55 percent of the land was cropland. Where dairy cows were the major enterprise, 30 percent of the land was cropland; and where the two enterprises ranked about the same, 42 percent of the land was devoted to crops. It will be noted that where major emphasis was placed on dairy cows, slightly more than half of the total land was devoted to open pasture. Where cotton received major emphasis, only 30 percent of the farm acreage was used for open pasture land.

Table 1. Use of land on 40 farms and on different types of farms in Northeast Mississippi, 1944

Land use	Average number of acres							
	40 farms		Dairy-cotton		Cotton-dairy		Dairy & cotton	
	Per farm	Pct. of total	Per farm	Pct. of total	Per farm	Pct. of total	Per farm	Pct. of total
Cropland	75	44.1	44	29.9	140	55.3	50	41.9
Open pasture, tillable	43	25.3	48	33.0	47	18.7	33	27.4
Open pasture, not tillable	21	12.4	27	18.4	28	11.0	8	6.5
Woods pastured	14	8.2	18	12.5	11	4.3	11	9.2
Woods not pastured	9	5.3	5	3.3	14	5.4	12	10.1
Other land	8	4.7	4	2.9	13	5.3	6	4.9
Total	170	100.0	146	100.0	253	100.0	120	100.0

Crop Acres

On the average, more acreas of land were devoted to corn than to cotton. Corn and cotton acreages were about the same on cotton-dairy farms. Hay constituted the largest acreage of any crop. Table 2 shows the relative importance of crops grown. Other than cotton, cash crops were relatively unimportant on most farms. Two farms produced hay for sale and one raised watermelons and cantaloupes for the market. It will be noted that less than one-half acre per farm was used for growing silage crops. Only six farmers grew silage. These six farms grew an average of 2 acres per farm.

Table 2. Crop acres on 40 farms and on different types of farms in Northeast Mississippi, 1944

Crop	40 farms		Dairy-cotton		Cotton-dairy		Dairy & cotton		Number of farms growing crops
	Acres per farm	Pct. of total	Acres per farm	Pct. of total	Acres per farm	Pct. of total	Acres per farm	Pct. of total	
Cotton	17.2	22.8	4.4	10.0	39.9	28.2	12.1	22.6	32
Corn	21.8	28.9	12.2	29.0	39.4	27.8	16.9	31.5	37
Oats	6.8	9.0	5.5	13.1	8.0	5.6	7.3	13.6	14
Soybeans (seed)	.2	.3	—	—	—	—	.5	.9	1
Lespedeza (seed)	.1	.1	—	—	—	—	.3	.6	1
Johnson grass hay	10.7	14.7	5.6	13.3	28.2	19.9	—	—	8
Lespedeza hay	2.4	3.2	3.8	9.2	2.1	1.5	.9	1.7	11
Soybean hay	8.3	11.0	5.8	13.8	15.7	11.1	4.5	8.4	21
Other hay	5.2	6.7	3.8	9.2	4.6	3.2	7.5	14.0	18
Total hay	26.6	35.3	19.0	45.1	50.6	35.7	12.9	24.1	—
Sorghum, silage	.4	.5	.5	1.2	.2	.1	.6	1.1	6
Sorghum, syrup	.1	.1	—	—	—	—	.3	.6	3
Truck and garden	.7	1.0	.4	1.0	1.5	1.1	.5	.9	40
Other crops	1.5	2.0	.1	.2	2.0	1.4	2.2	4.1	—
Crop acres[1]	75.4	100.0	42.1	100.0	141.6	100.0	53.6	100.0	—
Double crop acres[2]	3.0	—	2.4	—	6.7	—	5.1	—	—
Land cropped	72.4	—	39.7	—	134.9	—	48.5	—	—
Idle	2.7	—	4.3	—	5.1	—	1.6	—	—
Total cropland	75.1	—	44.0	—	140.0	—	50.1	—	—

1. Crop acres—Total acres of crops, includes double cropping.
2. Double-cropping acres are included in the above crop acreages.

On farms where dairying was the major enterprise, 74 percent of the acres cropped was devoted to feed crops; on cotton-dairy farms, 69 percent; and on dairy & cotton farms, 69 percent. Acres of oats per farm averaged 6.8. However, only 14 of the 40 farms actually growing oats had an average of 19.4 acres per farm.

Hay was an important crop on most of the farms. Johnson grass predominated in the Northeast Prairie Area, but in the Pontotoc Ridge and Northeast Highland Areas, soybean acreage for hay was greatest. Lespedeza was next in importance. A considerable number of farms interplanted corn with soybeans and harvested the plants for hay or stocked them down. Most of the farmers growing soybean hay, ground it before feeding it to dairy cows and other livestock.

Classes of Livestock

Dairy cows were the most numerous livestock on the average farm. Table 3 shows the importance of all classes of livestock. The average number of dairy cows per farm was 14, with a total value of $981 per farm, or an average value of $69 per cow. Milk cows constituted 47.3 percent of the total farm investment in livestock. The range in number of dairy cows for all farms was from 4 to 40. Only two farms milked less than 6 cows; 4 less than 7 cows; and 10 less than 10 cows. Nine farms milked 20 or more cows. Nineteen herds averaged 4,000 pounds per cow or more, and 8 had an average production of more than 5,000 pounds of milk per year. The range in the amount of milk produced per cow per year was from 2,200 pounds to 5,800 pounds with 4 herds producing less than 3,000 pounds per cow.

Table 3. Classes of livestock and their values on 40 farms in Northeast Mississippi, 1944

Class	Number per farm	Value per farm	Percent of total
Dairy cows	14.2[1]	$981	47.3
Other cattle	10.9	399	19.2
Hogs	9.1	106	5.1
Hens	80.0	84	4.1
Workstock	4.4	497	23.9
Other[2]	2.4	9	.4
Total	-------	2076	100.0

1. Average for 5 inventories during the year.
2. Average for 39 farms.

Other cattle[1] amounted to 11 head per farm and 19.2 percent of the total average investment in livestock. Other cattle consisted of bred heifers, steers, bulls, and calves. Hogs were of minor importance on more than 75 percent of all farms. A few farmers raised hogs for the market while all others grew hogs primarily for home consumption, selling the small surplus produced.

Most poultry flocks were for home use. However, a majority of the farms sold some eggs and a few sold young birds. Nine farms had more than 100 hens, and 4 had more than 150 hens.

Table 3 shows the importance of workstock. Next to milk cows, the largest investment in livestock was in the enterprise used for farm power.

Farm Investment

The investment per farm amounted to $10,743. The distribution of this investment is shown in table 4. Cotton-dairy farms had the largest investment, as might be expected on account of larger cropland requirements. Dairy-cotton and dairy & cotton farms were more nearly equal in real estate investment and total investment.

Table 4. Average farm capital per farm for 40 farms and by types of farms in Northeast Mississippi, 1944

Item	40 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton	Per acre 40 farms
	dollars	dollars	dollars	dollars	dollars
Land	4,073	2,422	7,712	2,635	23.96
Buildings	2,257	2,116	3,022	1,680	13.28
Fences	136	153	142	107	.80
Total real estate	6,466	4,691	10,876	4,422	38.04
Livestock	2,076	2,336	2,025	1,778	12.21
Equipment	1,039	986	1,436	713	6.11
Feeds	1,029	849	1,429	868	6.05
Miscellaneous supplies	133	87	236	95	.79
Total	10,743	8,949	16,002	7,876	63.20

Table 5 shows the relative distribution of farm investment for all farms as well as for types of farms. The average investment in real estate for the 40 farms was 60.2 percent. On cotton-dairy farms the investment in real estate was 68 percent, while dairy-cotton and dairy & cotton farms had a real estate investment of 52.5 and 56.1 percent, respectively. Investment in livestock was lowest on cotton-dairy farms. The relative investments in feeds and equipment were about the same.

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[1] All cattle other than milk cows. Only one farm had beef cattle.

On farms where dairy cows were the major enterprise and on farms where cows and cotton received about the same emphasis, the total investment per farm was approximately one-half of the investment on farms where cotton was the major enterprise. The percent return on investment for cotton-dairy farms was 10.4, on dairy-cotton farms 14.4 percent, and 16.2 percent on dairy & cotton farms.

Table 5. Distribution of investment on 40 farms and by types of farming in Northeast Mississippi, 1944

Item	Percent of investment			
	40 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton
Land	37.9	27.1	48.2	33.5
Buildings	21.0	23.7	18.9	21.3
Fences	1.3	1.7	.9	1.3
Total real estate	60.2	52.5	68.0	56.1
Livestock	19.3	26.1	12.7	22.6
Equipment	9.7	11.0	9.0	9.1
Feeds	9.6	9.5	8.9	11.0
Miscellaneous supplies	1.2	.9	1.4	1.2
Total	100.0	100.0	100.0	100.0

Farm Receipts and Expenses

Farm receipts are the total income from farm sources. They include money received or due from the sale of the current year's crops, sale of livestock and livestock products, sale of equipment and supplies, and any increase in the inventory value of the farm property. Farm receipts for the 40 farms averaged $5,930. (See table 6.)

Table 6. Financial summary for 40 farms and by types of farms in Northeast Mississippi, 1944

Item	40 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton
	dollars	dollars	dollars	dollars
1. Farm investment	10,743	8,949	16,002	7,876
2. Farm receipts	5,930	5,145	8,334	4,573
3. Farm expenses	3,973	3,298	6,106	2,740
4. Farm income (2 minus 3)	1,957	1,847	2,228	1,833
5. Interest on investment @ 5%	537	447	802	394
6. Labor income (4 minus 5)	1,420	1,400	1,426	1,439
7. Farm privileges	590	623	576	560
8. Labor earnings (6 plus 7)	2,010	2,023	2,002	1,999
9. Value operator's time*	557	557	557	557
10. Return on investment	1,400	1,290	1,671	1,276
11. Percent return on investment	13.0	14.4	10.4	16.2

*The operator's labor was valued at current wages for a hired man without meals and lodging for 12 months. Unpaid family labor was valued at the same rate.

Farm expenses represent the cost of operating the farm business, except for interest on investment and value of the operator's time. Farm expenses include all cash expenses for labor, feed, supplies, taxes, etc.; the value of unpaid family labor other than the operator's; the value of board furnished hired help; the cost of livestock and equipment purchased; and any decrease in the inventory value of farm property. Farm expenses, or farm business expenses, do not include family living expenses. The average farm expenses for 40 farms was $3,973.

Farm Returns

Farm income and other measures of return to the farm operator are also shown in table 6. Farm income, which is farm receipts less farm expenses, amounted to $1,957 for the 40 farms as a whole. Deducting from farm income the amount of interest at 5 percent on the average investment, gives a labor income of $1,420. Labor earnings are found by combining labor income and farm privileges.[1] This amounted to $2,010 per farm.

The operator's time was valued at current wages paid hired labor without board and lodging in Northeast Mississippi, as reported by the Bureau of Agricultural Economics. All operators were credited with 12 months of labor except one who spent some of his time off the farm.

Return on the average farm investment was $1,400 or 13 percent. The operator's time may have been undervalued. If that were true, the percentage return on investment would be less in proportion to the increase of the value of the operator's time.

Farm receipts and expenses for the different types of farms varied directly with the size of the investment.. However, it will be noticed that labor income did not vary much from one type to another. Causes for these differences and similarities will be discussed in following sections of this study.

Methods Used in Determining the Costs of Producing Milk

All farm costs were determined by means of a set of accounts kept by each farmer. Records began with taking an opening inventory, January 1, 1944, and included transactions during the year pertaining to the farm business. The closing inventory was taken December 31. Daily labor records, feeding records, production records. cash records, and other records were kept. Methods used in keeping these records follow.

Feed. Feeds fed to dairy cows were both purchased and produced on the farm. Most concentrates were purchased, whereas, practically all roughages were grown by the farmer. Purchased feeds were charged at market price, and home-grown feeds were charged at farm price. Farm price was market price less the cost of transportation to the market.

The amount of feeds fed was recorded monthly. Once each month—usually the latter part of the month—the farmer determined the pounds of concentrates and roughages fed to his herd for one day, and multiplied these amounts by the number of days in the month.

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[1] Farm privileges means contributions made by the farm to family living, such as house rent and foods.

If changes occurred in the kinds of feed fed during the month, or if the number of cows in the herd increased or decreased, this was taken into consideration in order not to overcharge or undercharge the proper amounts. The pasture cost was computed by determining the total pasture cost for all livestock and then allocating the proportionate part to the milk cows. This cost was estimated by the farmer.

Pasture. Pasture costs included interest on investment in pasture land, taxes, man and horse labor used on the pastures, and the cost of pasture fences. Crops grazed, such as oats, were charged at the rate of $3.00 per month for each milk cow.

Man labor. The charge for man labor was the average cost per hour for all labor on the farm except that of cotton croppers. Cropper cotton labor was charged directly to the cotton enterprise. Thus, the cost per man hour for all enterprises other than cotton was the average cost per hour on the farm for all labor except labor spent on cotton by cropper tenants. In addition to cash wages, labor costs included the value of the operator's time, unpaid family labor, and the use of tenant houses. The average rate per hour was determined by dividing the total labor costs, less the value of the cropper's share of the cotton and seed, by the total hours of work less the hours spent on cotton by croppers. The total cost of man labor for milk cows was completed by multiplying the average farm labor hour rate by the total hours spent on milk cows. Hours of labor spent on cows included the time spent in milking, feeding, cleaning milk house, and washing utensils.

Buildings. The cows were charged with their proportionate part of the cost of maintaining building for the year. This cost included repairs, depreciation, interest on investment, insurance and taxes. The total expense for any building used entirely for milk cows was charged to the herd.

Dairy equipment. The investment in equipment for most herds was small. This cost included depreciation, repairs, and interest on investment.

Depreciation on cows. Depreciation on milk cows was determinated by using the following formula: depreciation equals (value of cows at the beginning of year plus value of heifers freshening plus value of cows purchased) minus (value of cows at the end of year plus value of cows sold and any that died). This charge for depreciation accounts for both depreciation in the case of young cows and depreciation for old cows.

Interest. Milk cows were charged with interest at the rate of 5 percent on the average of the beginning and ending inventories values.

Milk hauling. Practically all farmers hired the hauling of their milk to the milk plants. Where the farmer hauled his own milk, man hours and the proportionate part of the truck, or car, costs used for handling the milk were estimated by the farmer.

Miscellaneous costs. Miscellaneous costs included such items as the proportionate part of truck or auto expense, electricity, sprays, disinfectants, veterinary services, medicines, etc.

Costs and Returns for Milk Production

Milk was produced for sale on all farms. About 12 percent of all milk produced was used on the farm. Practically all of the remaining 88 percent was sold to cheese plants and condenseries. A few farmers sold their milk to wholesale distributors.

The average number of milk cows per farm was 14. (See table 7.) This average number of milk cows per herd was computed from the beginning and ending inventories and five other inventories during the year. Milk produced per farm amounted to 55,991 pounds, or 3,931 pounds per cow. The family used 3,861 pounds of milk, and the average farm fed 2,729 pounds of milk to calves.

A study of table 7 shows the amount of costs for the various items entering into the total costs for the average dairy herd as well as per cow and per 100 pounds of milk. This table also shows herd credits, such as manure and calves produced, and the returns from milk produced. Detail consideration is given to these items in the sections that follow.

Table 7. Production, disposal and costs of and returns for milk on 40 farms in Northeast Mississippi, 1944

Item	Average per herd	Average per cow		Average 100 lbs. of milk	Proportion of total
		Amount	Value		
Costs	dollars	hours or pounds	dollars	dollars	percent
Feeds:					
Concentrates	608.37	1,516	42.71	1.09	32.7
Roughages	371.72	2,624	26.09	.66	20.0
Pasture	129.12	-------	9.06	.23	6.9
Total feed	1,109.21	-------	77.86	1.98	59.6
Man labor	507.35	145	35.62	.90	27.3
Horse labor	.15	-------	.01	.00	.0
Buildings	34.47	-------	2.42	.06	1.9
Equipment	18.05	-------	1.27	.03	1.0
Depreciation on cows	82.71	-------	5.81	.15	4.4
Interest	48.75	-------	3.42	.09	2.6
Miscellaneous	59.83	-------	4.20	.11	3.2
Gross farm costs	1,860.52	-------	130.61	3.32	100.0
Credits:					
Manure	108.35	-------	7.61	.19	-----
Calves	28.82	-------	2.02	.05	-----
Total credits	137.17	-------	9.63	.24	-----
Net farm costs	1,723.35	-------	120.98	3.08	-----
Hauling charges	126.09	-------	8.85	.25	-----
Total costs	1,849.44	-------	129.83	3.33	-----
Returns					
Milk returns:					
Milk sold	1,987.36	-------	139.51	4.02	-----
Milk used on farm	232.27	-------	16.31	-----	-----
Total milk returns	2,219.63	-------	155.82	-----	-----
Profit	370.19	-------	25.99	.69[1]	-----
Labor returns	877.54	-------	61.61	1.59[1]	-----

[1]/ Per 100 pounds sold.

Average number cows per herd	14	Milk produced per farm	55,991 lbs.
Average produced per cow	3,931	Milk sold per farm	49,401 lbs.
Pounds sold per cow	3,468	Personal use per farm	3,861 lbs.
		To calves per farm	2,729 lbs.

Feed Costs

Feed was the largest item of cost in the production of milk. (See table 7.) The feed cost per herd for one year on all farms averaged $1,109. Of this, concentrates amounted to $608; roughage, $372; and pasture, $129. This total feed cost amounted to 59.6 percent of total milk production costs. On a per cow basis, this feed cost per year was $78, and the feed cost to produce 100 pounds of milk was $1.98.

The amount of feed per cow varied considerably, and much of this variation was due to whether there was available suitable land for hay and pasture production in the three soils areas in Northeast Mississippi—Black Prairie, Northeast Highland, and Pontotoc Ridge. The five farms feeding the least concentrates averaged 642 pounds per cow. The five farms feeding the most concentrates averaged 2,898 pounds per cow. The five farms feeding the least roughage averaged 969 pounds per cow, and the five farms feeding the most roughage averaged 5,157 pounds per cow. The capacity of milk cows, the knowledge of farmers relative to desirable feeding standards, and high feed costs were other factors contributing to the wide variation in the amounts of feed fed on various farms.

Tables 8 and 9 show the relationships of concentrates and roughages fed per cow to milk produced per cow, and the cost to produce 100 pounds of milk. When concentrates fed per cow were increased, milk produced per cow increased. On the other hand, when roughage per cow was increased, there was a slight decrease in the amount of milk produced. The cost to produce milk increased as the amount of both concentrates and roughage fed per cow was increased.

Table 8. Concentrates fed per cow related to various factors on 40 farms in Northeast Mississippi, 1944

Concentrates per cow, pounds	Number of farms	Average concentrates per cow	Milk per cow	Cost per 100 lbs. milk	Roughage per cow
		pounds	pounds	dollars	pounds
Less than 1,500	23	851	3,774	3.08	2,518
1,500-3,000	15	2,020	4,347	3.78	3,112
3,000 and over	2	3,297	5,150	3.25	1,609

Table 9. Roughage fed per cow related to various factors on 40 farms in Northeast Mississippi, 1944

Roughage per cow, pounds	Number of farms	Average roughage per cow	Milk per cow	Cost per 100 lbs. milk	Concentrates per cow
Less than 1,500	7	1,085	4,186	2.58	1,609
1,500-3,000	20	2,280	4,085	3.22	1,347
3,000 and over	13	4.202	3,946	3.95	1,404

Feed costs varied considerably according to type of farming. Table 10 shows the cost items for the production of milk on all farms, dairy-cotton farms, cotton-dairy farms, and dairy & cotton farms, as well as for the five lowest cost[1] farms and the five highest cost[1] farms.

Concentrates fed during the year to cows on dairy-cotton farms amounted to $50.51 per cow, which was the highest value of the three types of farms. This could be expected on farms where farmers placed the most emphasis on the dairy enterprise. However, these same farms had the least roughage cost of $23.70 per cow, compared with $32.14 for cotton-dairy farms, and $24.66 for dairy & cotton farms. Total feed costs were the greatest on dairy-cotton farms, next on cotton-dairy, and least on dairy & cotton farms.

The five farms producing milk at lowest cost, fed $43.10 worth of feed per cow, and the five farms producing milk at the highest cost fed $96.34 worth of feed. Since cows on high cost farms produced only 3,230 pounds each, this would indicate that these farm operators were attempting to get high production out of cows of low efficiency.

Man Labor Costs

Labor used to produce milk was furnished primarily by members of the operator's family. A few farmers hired some labor for the dairy enterprise, paying cash wages, a part of the milk check, or by allowing the helper so much milk for family use. Farm labor was very scarce in 1944 and, consequently, high priced. Due to this fact, labor costs were relatively higher than other fixed costs as buildings, equipment, depreciation on cows, and interest charges.

The cost of labor per herd was $507 as shown in table 7. The average number of man hours spent on one cow per year was 145, and was valued at $35.62. This amounted to 91 cents per 100 pounds of milk produced. The labor cost range for 100 pounds of milk was from 46 cents to $1.65. The amount of labor used per cow for one year ranged from a low of 96 hours for the 10 lowest farms to a high of 209 hours per cow for the 10 farms requiring the greatest amount of labor. The average cost of labor per hour spent on milk cows on all 40 farms was 24.5 cents. The range for this man-hour costs was from 16.4 cents to 39.5 cents. In producing milk, man labor accounted for 27.3 percent of the gross farm cost to produce 100 pounds of milk. Consequently the efficient use of labor is an important factor in producing milk economically.

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[1] Based on the cost to produce 100 pounds of milk.

Table 10. Production, disposal, costs and returns of milk per cow by types of farms in Northeast Mississippi, 1944

Item	Average 40 farms	Type of farm				Five high cost farms[1]
		Dairy-cotton (16 farms)	Cotton-dairy (12 farms)	Dairy & cotton (12 farms)	Five low cost farms[1]	
No. farms	40	16	12	12	5	5
No. cows per farm	14	19	12	10	11	15
Lbs. milk per farm	3931	3993	3413	4392	4633	3230
Man hours per cow	145	148	158	124	124	179
Costs						
Feeds:						
Concentrates	$42.71	$50.51	$32.65	$36.02	$18.55	$41.39
Roughages	26.09	23.70	32.14	24.66	17.16	42.95
Pasture	9.06	7.62	13.39	7.42	7.39	12.00
Total feed	77.86	81.83	78.18	68.10	43.10	96.34
Man labor	35.62	33.32	41.83	33.77	31.63	42.63
Buildings	2.42	2.12	3.35	2.02	1.47	2.65
Equipment	1.27	1.64	.97	.73	.49	1.45
Depreciation on cows	5.81	2.88	7.64	10.59	8.16	12.51
Interest	3.42	3.45	3.13	3.69	3.00	3.17
Miscellaneous	4.20	3.82	5.03	4.14	1.96	4.88
Horse labor	.01	.02	—	—	—	—
Gross farm costs	130.61	129.08	140.13	123.05	89.81	163.63
Credits:						
Manure	7.61	7.63	7.67	7.46	7.49	7.57
Calves	2.02	1.56	2.52	2.54	2.17	2.47
Total credits	9.63	9.19	10.19	10.00	9.66	10.04
Net farm costs	120.98	119.89	129.94	113.05	80.15	153.59
Hauling charges	8.85	8.98	7.61	10.02	11.61	6.80
Total costs	129.83	128.87	137.55	123.07	91.76	160.39
Returns						
Milk returns:						
Milk sold	$139.51	$151.05	$111.30	$145.30	$144.46	$114.84
Milk used on farm	16.31	13.62	19.03	19.47	24.44	12.87
Total milk returns	155.82	164.67	130.33	164.77	168.90	127.71
Profit	25.99	35.81	—7.22	41.70	77.14	—32.68
Labor returns	61.61	69.12	34.61	75.47	108.77	9.95

1. The cost of producing 100 pounds of milk.

The cost of producing milk on dairy and cotton farms was lowest and profit per cow was highest. Dairy and cotton farms spent less for feeds, less than average for labor, and had the highest production per cow.

Building Costs

Milk cows were charged with building costs on the basis of the proportionate part of the barn used by the cows. This cost amounted to $34.47 per herd for the year, or $2.42 per cow. The building cost per 100 pounds of milk produced was $0.06.

Equipment Costs

Equipment cost per herd amounted to $18.05. The cost per cow for one year was $1.27, and the cost per 100 pounds of milk produced was $0.03.

Depreciation Costs

The depreciation on the average herd of cows was $82.71. This amounted to $5.81 per cow, or 15 cents per 100 pounds of milk produced. This cost accounted for 4.4 percent of the total gross farm cost of producing milk.

Interest Cost

Interest cost at 5 percent on the average investment in the herd amounted to $48.75. This was equivalent to $3.42 per cow and about $0.09 per 100 pounds of milk produced.

Miscellaneous Costs

Miscellaneous costs were $59.83 per herd, or $4.20 per cow. This cost amounted to about $0.10 per 100 pounds of milk produced.

Gross Farm Costs

The gross farm costs per herd for the year was $1,860. Thus, the average gross cost to keep a cow for one year was $130.61, and this amounted to $3.32 per 100 pounds of milk produced. The range of cost for keeping a cow for one year on the entire 40 farms was from $73 to $257. The range in cost of producing 100 pounds of milk was from $1.77 to $5.56.

Credits

Each cow was credited with 5 tons of manure since this was the estimated amount that was saved per cow. The manure was valued at $1.50 per ton. Credit for calves produced amounted to $2.00 per cow. Total credits were $137.17 for each herd or $9.63 per cow. This credit amounted to $0.24 per 100 pounds of milk produced.

Net Farm Costs

Net farm costs are gross farm costs less total credits. Net farm costs amounted to $1,723 per herd as shown in table 7. This gave a net cost of $121 per cow and $3.08 per 100 pounds of milk produced.

Hauling Charges

Charges for hauling milk to the milk plant for the year amounted to $126 per herd, $8.85 per cow, and about $0.025 per 100 pounds of milk. When adding this cost to net farm costs, it gives a cost of $3.33 per 100 pounds of milk delivered at the plant.

Returns For Milk Sold

The amount of milk sold per farm was 49,401 pounds, or 3,468 pounds per cow. This amount of milk delivered at the milk plant sold for $1,987. Thus the average price received for 100 pounds of milk by the farms was $4.02. This price per 100 pounds was slightly above the average milk plant price for the area due to several of the farms producing grade A milk for army camps and for starter milk at cheese plants. This better grade of milk sold at a premium.

Milk Used on the Farm

Milk used for personal purposes per farm amounted to 3,861 pounds per herd, and milk fed to calves was 2,729 pounds per farm. Thus the total amount of milk used on each farm had a farm value of $232.

Profit

Profit was determined by deducting farm costs and hauling charges (total costs) from total milk returns. Total milk returns per herd amounted to $2,219. Net farm costs per herd plus hauling charges amounted to $1,849. Thus the profit per herd was $370 and per cow, $25.99. The profit per 100 pounds of milk was the average price received ($4.02) less the total cost per 100 pounds ($3.33), and amounted to $0.69.

Labor Return

Assuming that profit on the enterprise is also a return to labor, the total return to labor would be profit on the enterprise plus man labor charges to the enterprise. The sum of $370 (profit) and $507 (labor charges) gives a labor return of $877. This amounts to $61.61 per cow, and $1.59 per 100 pounds of milk sold.

What a farmer receives for his labor is of paramount importance to him. He has opportunities to use his labor in various ways and that combination of ways which gives the greatest return for the farm business as a whole, is the one he is continually seeking. These ways of using labor, of course, take form in the various enterprises conducted on the farm.

Much of the labor used on the farms in this study was unpaid family labor. Oftentimes this labor may be used on an enterprise when the cost of production is relatively high, particularly where it is convenient to engage in that enterprise, and still receive income that adds to the well-being of the farmer and his family. In case of the dairy enterprise, the farmer charges the cows with grain, hay, and other feeds at farm value (market value less transportation costs) instead of what they actually cost. Consequently, an enterprise may show a loss when its physical input costs are charged at farm value, yet the farmer can afford to go right along producing the enterprise and will be better off by doing so unless some alternative enterprise opportunity appears whereby he can get more for his input costs or values.

Of the 10 farms that made minus incomes on dairy cows, only 3 made a minus labor return per cow. One farmer lost $31 per cow, but his labor return per cow was $30 and the labor return per hour spent producing milk was $0.17. Another farmer had a loss of $4 per cow, yet his labor return per cow was $51 and the return per hour spent on milk cows was $0.32. If profit and loss had been computed on the basis of actual costs of producing feed on the farm, the return for labor would have been considerably more. Therefore, if a farmer receives the cost of production for 100 pounds of milk or a hundred pounds of cotton, that price includes the current wage rate for his labor and for all unpaid family labor. However, farmers are entitled to a fair profit above actual costs, as is expected in any other business, in order that they build up reserves for depression periods and for old age.

Costs and Returns per Cow on Different Type Farms

A study of table 10 shows costs and returns for the dairy enterprise by types of farming on a per cow basis. The average costs and returns per cow for the 40 farms is repeated for comparative purposes.

The annual net cost to keep a cow for one year on dairy-cotton farms amounted to $120. The costs on cotton-dairy farms were $130, and $113 on dairy & cotton farms. The annual profit per cow was $36 for dairy-cotton farms. There was a loss of $7 per cow for cotton-dairy farms, and a gain of $42 on dairy & cotton farms. It will be noticed that the profit was considerably greater on the farms where there was balanced emphasis on milk cows and cotton. Also, it will be noticed that cows on the dairy & cotton farms produced an average of 4,392 pounds of milk. That was a production of 400 pounds per cow above the dairy-cotton farms, and 1,000 pounds more than on cotton-dairy farms. Feed costs and net farm costs per cow were less than on the other two types of farms.

The differences between farm types pointed out in the preceding paragraph are favorable to those farmers who placed about the same emphasis on both cotton and milk cows in their farm program. Since, dairy & cotton farms used fewer man hours per cow, spent less for feed, and got a higher production from their cows, it would seem that their cows were more profitable because labor was used more efficiently and their cows were more efficient in converting feeds into milk. The pounds of concentrates fed per cow on dairy & cotton farms were about the same as fed on the other types of farms. The roughage fed per cow was from 200 to 400 pounds less per cow. Pasture conditions on dairy & cotton farms were somewhat better than on dairy-cotton farms and about the same as on cotton-dairy farms.

Labor returns per cow were likewise greater on dairy & cotton farms. This return was 118 percent greater, or more than twice as great as the labor return on farms where emphasis was placed mainly on cotton. It was, however, only 9 percent greater than labor return per cow on farms placing major emphasis on the dairy enterprise.

Cotton Production Costs and Returns

Cotton was produced on 32 of the 40 farms on which records were kept. An average of 21.8 acres of cotton was produced on each farm. Actual bales ginned per farm was 20.2 or nearly one bale per acre. The number of 500-pound bales produced per farm was 21.3. The average price received per pound of lint cotton for all farms was 21.21 cents, and the cost to produce one pound of lint was 13.28 cents.

A study of table 11 shows the amount of cost items for the average cotton enterprise on 32 farms. The average cost of each item is shown for the total cotton enterprise, one acre of seed cotton, one 500-pound bale and seed, 500 pounds of lint, total lint, total seed, the cost of producing one pound of lint, and the proportionate part each item of cost was of the total cost of producing one pound of lint. Items of cotton cost are discussed in the following paragraphs.

Man Labor

It will be observed, table 11, that man labor was the largest item of costs in producing cotton. The total man-labor cost for the average cotton enterprise on 32 farms in Northeast Mississippi was $1,089. This labor cost was $50 per acre of cotton grown, $51 per 500-pound bale and seed, and $40 per 500 pounds of lint. Man-labor cost per pound of lint was 8.04 cents, which constituted 60.5 percent of the total cost to produce one pound. Consequently, any steps taken by farmers to reduce the cost of producing cotton will necessarily include the consideration of man labor.

The man labor required to grow an acre of cotton amounted to 141 hours, and only 3 hours more were required to produce a 500-pound bale since production was so near one bale per acre. The range in hours required per acre of cotton on the 32 farms was from 63 to 176. Barring the fact that there were differences in yield per acre among farms, there still would be much room for increasing the efficiency of labor. And since this cost item is 60.5 percent of the total cost of production, farmers could well look to using available labor on the farm, as well as hired labor, to a more distinctive advantage.

Table 11. Production, values, and average costs and returns per farm for cotton on 32 farms in Northeast Mississippi, 1944

	Production:		Values: (Dollars received)	
Cotton acres, 21.77	Total seed cotton	26,109 lbs.	Total seed cotton	2,646.14
Bales ginned, 20.23	Total lint	10,671 lbs.	Total lint	2,263.72
Man hours per acre 141	Total seed	15,438 lbs.	Lint per pound	0.2121
	500 lb. bales	21.34 lbs.	Total seed	382.42

Item	Total crop	One acre seed cotton	One 500-lb. bale and seed	500 lbs. of lint*	Total lint*	Total seed	Lint Per lb.*	Lint Percent of total
Costs:								
	dollars	dollars	dollars	dollars	dollars	dollars	cents	percent
Land	67	3.08	3.14	2.47	53	14	0.50	3.7
Fertilizer	107	4.92	5.01	3.95	84	23	0.79	6.0
Manure	38	1.76	1.80	1.42	30	8	0.28	2.1
Seed	43	1.97	2.01	1.59	34	9	0.32	2.4
Man labor	1,089	50.02	51.02	40.18	857	231	8.04	60.5
Horse labor	195	8.95	9.13	7.19	153	41	1.42	10.8
Tractor	22	1.01	1.02	.81	17	5	0.16	1.2
Other equipment	54	2.48	2.53	1.99	43	12	0.40	3.0
Ginning	108	4.96	5.06	3.98	85	23	0.80	6.0
Miscellaneous	77	3.53	3.60	2.84	61	16	0.57	4.3
Total costs	1,800	82.68	84.32	66.40	1,417	382	13.28	100.0
Returns:								
Total lint	2,264	104.01	106.07	—	—	—	—	—
Total seed	382	17.57	17.92	—	—	—	—	—
Total	2,646	121.58	123.99	106.07	2,264	382	21.21	—
Gain	846	38.90	39.67	39.67	846	0	7.93	—

*Cost of lint cotton is determined by the total costs of seed cotton minus total value (amount received) of seed.

Horse Labor

Labor performed by workstock held the second place in magnitude of cost. Horse labor used to produce cotton averaged $195 per farm or $8.95 per acre. The cost of horse labor to produce one pound of lint cotton was 1.42 cents, or 10.8 percent of the total cost to produce one pound.

Land

Land costs (interest on investment, taxes, improvements) per farm for the cotton enterprise on 32 farms in Northeast Mississippi was $67. This amounted to $3.08 per acre and $3.14 per 500-pound bale and seed. The land cost per 500-pound bale of lint was $2.47, and the average cost per pound of lint was 0.5 cent. This one-half cent land cost per pound of lint was 3.7 percent of the total cost to produce a pound of lint. The average value per acre of land only for the 32 farms was $23.96. Total farm investment per acre was $63.20.

Fertilizer

All but six of the 32 farms used fertilizer in the production of cotton. Fertilizer costs for cotton were $107 per farm or $4.92 per acre. This was considerably more than the cost of land per acre. The fertilizer expense per pound of lint was 0.79 cent, or 6 percent of the total cost of 13.28 cents to produce a pound of lint.

Manure

Twenty-six of the 32 farms growing cotton applied manure in its production. The amount used was very small, since the average value of manure applied per acre on farms growing cotton was only $1.76 or $38 per farm. Thus the manure cost per pound of lint cotton was 0.28 cent. This was 2.1 percent of the total cost of producing one pound of lint.

Cottonseed

Cottonseed for planting cost $43 per farm and $1.97 per acre of cotton. This expense amounted to 0.32 cent per pound of lint and 2.4 percent of the cost of producing one pound of lint.

Tractor Expense

Tractor expense for producing cotton averaged $22 per farm for the farms growing cotton. Seventeen of these farms owned tractors. Since the average cost per hour for operating tractors was 49 cents, it is readily seen that the tractors were used only for a few hours on the cotton enterprise. When tractors were used, it was principally for plowing early in the year.

Other Equipment

Other equipment consisted of all equipment on farms except tractors. This cost averaged $54 per farm or $2.48 per acre for the equipment used in producing cotton. Equipment cost per pound of lint amounted to 0.40 cent, or 3 percent of the total cost to produce one pound of lint.

Ginning

The expense of ginning averaged $108 per farm and $4.96 per acre of cotton. This cost averaged $5.06 per 500-pound bale. This charge was fairly standard in all communities. Ginning cost was 0.80 cent per pound of lint and 6 percent of the total cost to produce one pound of lint. This cost per pound of lint was twice that of farm equipment and almost twice the cost of land. As an expense of production, ginning came next in importance after man and horse labor costs.

Miscellaneous Costs

Miscellaneous costs amounted to $3.53 per acre and 0.57 cent per pound for lint. This expense was 4.3 percent of the total cost of producing one pound of lint.

Total Costs of Producing Cotton

The average cost of producing the cotton enterprise on each of the 32 farms was $1,800, which amounted to $83 per acre. (See table 11.) The cost to produce 500 pounds of lint was $66, which gave a cost of 13.28 cents per pound for lint cotton. This return from one acre of cotton for lime and seed was $104 and $17.57, respectively. The total return from the enterprise per farm was $2,646, thereby leaving a profit of $846 for the cotton enterprise and $38.90 per acre produced. With a cost per pound of lint at 13.28 cents and an average price of 21.21 cents received per pound, this gave a profit of 7.93 cents per pound of lint to the farmers growing cotton.

Costs of Cotton Production on Different Type Farms

Table 12 shows the average amount of cotton produced per farm for 32 farms in Northeast Mississippi as well as the amounts produced on dairy-cotton, cotton-dairy, and dairy & cotton farms. Items of cost of production are also given. There was much variation in the acreage devoted to cotton production on the three types of farms. The range was from 9.1 acres per farm on dairy-cotton farms to 39.9 acres on cotton-dairy farms. Dairy & cotton farms produced 12.1 acres, which was only 3 acres more than was produced on dairy-cotton farms, and less than one-third of the acres grown on cotton-dairy farms. The number of acres produced on the five low-cost farms and the five high-cost farms was about the same, and approximately the same as was produced on dairy & cotton farms.

Table 12. Acres in cotton, bales produced, and the costs and returns per acre for cotton on 32 farms in Northeast Mississippi, 1944

Items	Average	Dairy-cotton	Cotton-dairy	Dairy and cotton	Five low cost farms[1]	Five high cost farms[1]
Number of farms	32	8	12	12	-------	-------
Acres in cotton	21.8	9.1	39.9	12.1	12.10	13.90
500 lb. bales produced	21.3	6.0	40.3	12.6	13.83	10.77
500 lb. bales per acre	.98	.67	1.01	1.04	1.14	.78
Man hours per acre	141	112	151	120	113	122
Costs						
Land	$ 3.08	$3.37	$3.19	$2.59	$3.26	$2.42
Fertilizer	4.92	2.39	5.32	4.83	5.33	4.61
Manure	1.76	3.03	.91	3.92	2.01	4.10
Seed	1.97	2.30	1.66	2.85	2.63	2.05
Man labor	50.02	28.15	53.68	48.89	37.42	44.55
Horse labor	8.95	7.88	9.18	8.71	6.23	9.95
Tractor	1.01	.62	1.08	.94	1.20	1.71
Other equipment	2.48	3.62	2.31	2.46	2.01	2.13
Ginning	4.96	3.56	5.05	5.36	5.80	3.95
Miscellaneous	3.53	1.96	3.86	3.25	2.52	5.37
Total costs	$82.68	$56.88	$86.24	$83.80	$68.41	$80.84
Cost per pound of lint, cents	13.28	13.31	13.55	12.42	8.24	17.17
Returns						
Lint	$104.01	$17.27	$106.42	$112.38	$122.11	$84.94
Seed	17.57	12.44	17.86	19.16	21.32	14.28
Total returns	121.58	83.71	124.28	131.54	143.43	99.22
Profit	38.90	26.83	38.04	47.74	75.02	18.38
Labor return per acre	88.92	54.98	91.72	96.63	112.44	62.93

[1] Based on cost per pound of lint.

The items of cost in the production of cotton varied considerably in value for the three types of farms. Man labor per acre, the most important cost item, was least on dairy-cotton farms and the most on cotton-dairy farms, $28 and $54 respectively. This cost was $49 per acre on dairy & cotton farms. Horse labor costs followed the same pattern. The low cost of man labor to produce an acre of cotton on dairy-cotton farms probably was due more to the smaller yield of cotton per acre than to more efficient use of labor on dairy & cotton farms.

Fertilizer costs varied from $2.39 per acre on dairy-cotton farms to $5.32 on cotton-dairy farms. The five farms producing cotton at the least cost per pound used $5.33 worth of fertilizer per acre. The total cost of producing a pound of lint on the three types of farms did not vary much, but was least on dairy & cotton farms. (See table 12.) It will be seen that the cost of production per pound on the five low cost farms was only 8.24 cents, while on the five high cost farms, the cost to produce one pound of lint was 17.17 cents.

Cotton Returns on Different Type Farms

Total returns per acre of cotton was the smallest on dairy-cotton farms. (See table 12.) This is largely the reflection of a low yield per acre for this type of farming. The average return per acre for all types was $122; for dairy-cotton, $84; for cotton-dairy, $124; and for dairy & cotton, $132. Profits per acre were $39, $27, $38, and $48, respectively. The five farms producing cotton at the lowest cost per pound—8.24 cents—had a profit of $75 per acre, whereas $18.38 was the profit per acre on the five farms producing cotton at the highest cost per pound, which was 17.17 cents.

Considering returns and profits as a whole, it appears that the yield per acre was the most important factor determining the cost to produce a pound of cotton and the return the farmer got for his labor.

Costs and Returns for Other Enterprises

Costs and Returns on Corn

Thirty-seven of the 40 farms keeping records produced corn. Acres per farm averaged 25.3 and the production per acre was 23.3 bushels. On the average, 27.8 man hours and 26.7 horse hours of labor were required per acre.

Table 13. Costs and returns for corn on 37 farms in Northeast Mississippi, 1944

Item	Quantity per acre	Value per farm	Value per acre	Per bushel Value	Per bushel Percent of total
		dollars	dollars	cents	percent
Costs:					
Land		81.39	3.21	13.8	14.5
Fertilizer		20.95	0.83	3.5	3.7
Manure		7.69	0.30	1.3	1.4
Seed		9.54	0.38	1.6	1.7
Man labor	27.8 hrs.	197.07	7.78	33.4	35.0
Horse labor	26.7 hrs.	159.18	6.29	27.0	28.3
Tractor	3.5 hrs.	41.62	1.64	7.0	7.4
Other equipment		28.92	1.14	4.9	5.1
Miscellaneous		16.68	0.66	2.8	2.9
Total costs		563.06	22.23	95.5	100.0
Returns:					
Corn	23.3 bu.	714.00	28.19	121.0	
Profit		150.94	5.96	25.5	

Acres per farm	25.3	Cost per bushel	$0.96
Return per hour of labor	$0.49	Value per bushel	$1.21

The total average cost per farm for the corn enterprise was $563, or $22.23 per acre. (See table 13.) With a production of 23.3 bushels per acre, this resulted in a cost of 95.5 cents per bushel. Again, as can be seen, the largest item of cost was labor. Man labor cost amounted to 35 percent of the total cost to produce a bushel of corn. Horse labor accounted for 28.3 percent. It will be recalled that the proportionate part of the total cost to produce one pound of cotton was 60.5 percent for man labor and 10.8 percent for horse labor. In the case of corn, horse labor has assumed a larger part of the cost. Again it will be noticed that the land cost to produce a bushel of corn was 13.8 cents. This amounts to 14.5 percent of the total cost to produce a bushel of corn, whereas the land cost to produce a pound of cotton was 0.5 cent, or 3.7 percent of the total cost to produce a pound.

The total return per farm from the corn enterprise was $714, or $28.19 per acre. The average farm value per bushel was $1.25. With a cost of 95.5 cents per bushel, this gave the farmers a profit of $151 for the corn enterprise, $5.96 per acre, and 25.5 cents per bushel. The labor return per hour spent on corn was $0.49.

Costs and Returns for Hogs

Thirty-eight of the 40 farms produced hogs. Only a few farmers produced for the market. Sales by others were for the purpose of disposing of a small surplus produced.

Table 14 shows that it cost $12.41 gross to produce 100 pounds of live pork. Of this amount 83.5 percent was for feed. On an average, 306 pounds of corn valued at $7.54, 82 pounds of other feed valued at $2.66, and pasture valued at 16 cents constituted the kinds, amounts, and values of feeds fed to produce this 100 pounds of live pork. It required 5.8 hours of man labor per 100 pounds of pork valued at $1.46 which represented 11.8 percent of the total cost to produce 100 pounds of pork.

Considering credits of manure and miscellaneous credits which amounted to $0.38 per 100 pounds, the net cost to produce 100 pounds was $12.03. The value per 100 pounds of live pork produced was $12.53, which left a profit of $0.50 per 100 pounds. This small profit on producing hogs was due to the unfavorable hog-corn ratio in Northeast Mississippi in 1944.

Table 14. Costs and returns for hogs on 38 farms in Northeast Mississippi, 1944

Items	Quantity per 100 lbs. liveweight	Value per lb. produced	Percent of total
Cost:			
		dollars	percent
Corn	306 lbs.	7.54	60.8
Pasture		0.16	1.3
Other feed	82 lbs.	2.66	21.4
Total feed	388	10.36	83.5
Man labor	5.8 hrs.	1.46	11.8
Horse labor		0.16	1.3
Buildings		0.05	.4
Interest		0.26	2.1
Miscellaneous		0.12	.9
Total costs		12.41	100.0
Credits:			
Manure		0.37	-----
Miscellaneous		0.01	-----
Total credits		0.38	-----
Net cost		12.03	-----
Value produced		12.53	-----
Profit		0.50	-----

Workstock Costs

Workstock was used on all farms and there was an average of 4.3 head per farm. Each head of workstock worked 462 hours, or 46 work days of 10 hours each during the year. The average cost for all farms was 22.9 cents per hour.

Table 15 shows the items of cost included in keeping workstock for one year. Feed amounted to $88 per head which was 78.1 percent of total costs. Two thousand seventy-six pounds of concentrates, principally corn, were fed per head at a cost of $52. Roughage fed per head amounted to 2,263 pounds valued at $30. Pasture was charged at actual cost or $6.47 per head. Man labor to care for one head of workstock for a year was 35.8 hours, which cost $9.89. Costs other than feed and man labor amounted to $14.95. A manure credit of $7.50 per head was deducted from total gross costs per head of $113, which resulted in a net cost of $106 to keep one head of workstock for a year.

Since workstock worked only 46 days per head during the year, some attention should be given to utilizing workstock labor more efficiently.

Table 15. Workstock costs on 40 farms in Northeast Mississippi, 1944

Items	Quantity per head	Values per farm	Value per head	Proportion of total
		dollars	dollars	
Costs:				
Concentrates	2076 lbs.	226.00	52.22	46.1
Roughage	2263 lbs.	129.00	29.79	26.3
Pasture		28.00	6.47	5.7
Total feed		383.00	88.48	78.1
Man labor	35.8 hrs.	43.00	9.89	8.7
Buildings		13.00	2.89	2.6
Equipment		7.00	1.58	1.4
Depreciation		14.00	3.29	2.9
Interest		24.00	5.58	4.9
Miscellaneous		7.00	1.61	1.4
Total costs		491.00	113.32	100.0
Credits:				
Manure		32.00	7.50	6.6
Net costs		459.00	105.82	93.4

Average head per farm 4.3 Hours worked per head 462
Cost per hour 22.9 cents

Factors That Affect Costs and Returns

Size of Business

Size is an important factor that affects all business enterprise and particularly is this true of farming. Farm income and the family standard of living are largely determined by this factor. The size of a farm business can be measured in several ways. Number of acres operated, capital investment, crop acres, amount of labor used, number of units comprising the major enterprises such as acres of cotton, number of milk cows in the herd, are measures commonly used. The more desirable measure to use in determining the size of a farm business depends a great deal on the type of farming followed.

Some of the measures used to show the size of the 40 farm businesses are shown in table 16. Acres per farm for all farms averaged 170, with a total investment of $10,743. Cotton-dairy farms had more total acres, cotton acres, crop acres, and a larger investment than the dairy-cotton or dairy & cotton farms. This could be expected since emphasis was placed on cropping. As a whole, cotton-dairy businesses were the largest, dairy-cotton farms next, and the dairy & cotton farms the smallest.

When considering the size of business in the Northeast Prairie, Northeast Highland, and Pontotoc Ridge Soil Areas, it will be noticed that the Prairie farms ranked highest in all measures. (Table 16). The Northeast Highland Area was next in all measures and the Pontotoc Ridge Area was the lowest in all measures.

Table 16. Size of farm business by type of farms and in major soil areas of Northeast Mississippi, 1944

Item	All farms	Type of farm			Soil area		
		Dairy-cotton	Cotton-dairy	Dairy & cotton	N. E. Prairie	N. E. High-land	Pontotoc Ridge
				average per farm			
Number of cows	14	19	12	10	17	13	7
Acres of cotton	21.8	9.1	39.9	12.1	29	14	11
Crop acres	75.4	42.1	141.6	53.6	94	54	49
Total acres operated	170.0	146.0	253.0	120.0	206	141	109
Total man Work units	494	508	594	377	561	442	373
Investment	$10,743	$8,949	$16,002	$7,876	$12,800	$9,083	$7,871

Man work units.[1] Since man labor is a common denominator of all farms, table 17 was constructed to show the relation of man work units per farm to and among other important factors. As the man work units per farm increased, the number of cows increased, acres of cotton increased very pronouncedly, and labor income increased. Costs and returns and the efficiency in the use of labor are not shown in this table because the averages for these important casual factors were found to be significantly different for the three types of farming; namely, dairy-cotton, cotton-dairy, and dairy & cotton.

Number of cows. When considering the relation of the number of milk cows per farm to production, costs and returns, the relationships were not altogether consistent. (See table 18.) The five smallest herds had the highest production per cow, the lowest cost per 100 pounds of milk, and the highest return per hour of labor. However, it should be pointed out that after getting away from these small herds, man hours per cow did decrease, and the labor return per hour spent on cows increased, as the number of milk cows in the herd increased.

Table 17. Man work units related to various factors on 40 farms in Northeast Mississippi, 1944

Man work units per farm	Number farms	Work units per farm	Milk cows	Acres of cotton	Labor income
Below 300	6	270	11	10.0	$1,097
300 - 499	15	380	10	14.8	1,289
500 - 699	15	584	18	20.6	1,325
700 - 899	2	748	19	38.0	2,492
900 and over	2	1,099	28	84.0	3,016
Total	40	494	14	21.8	1,419

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[1] A man work unit is 10 hours of production from work performed by one man.

Table 18. Size of herd related to various factors on 16 dairy-cotton farms in Northeast Mississippi, 1944

Number of cows	Number of farms	Cows per farm	Cost per 100 lbs. milk	Man hours per cow	Labor return per hour	Milk per cow
	number	number	dollars	hours	dollars	pounds
7 - 12	5	10	2.80	137	0.63	4,460
13 - 18	4	15	3.30	167	0.37	3,425
19 - 24	4	23	3.40	148	0.40	3,950
25 and over	3	32	3.40	134	0.60	4,066
Total	16	19	3.27	148	0.47	4,000

The same relationship was obtained when all 40 of the farms were likewise considered. A larger number of cases would no doubt show a more direct relationship between the size of herd and other important factors.

Acres of cotton. Acres of cotton per farm varied considerably. (See table 19.)

Labor requirements increased per 500-pound bale produced as the acres of cotton per farm increased on farms that grew more than 10 acres. Under increasing mechanization conditions the reverse of this relationship would be expected. However, practically all of the cotton production on the 32 farms was performed by man and horse labor. Thus it would appear that labor is being used less efficiently on the larger farms. The same relationship exists when considering cotton-dairy farms alone.

Larger farms have more cropper tenants, and according to data presented in table 19, such labor is not as efficient as the labor furnished by the operator, members of his family, and the small amount of labor hired during the year on the smaller farms. Labor income increases as the size of the cotton enterprise increases, but labor income does not necessarily reflect efficient use of cropper labor on farms when considering the size of the business.

Table 19. Acres of cotton per farm related to labor requirements and returns on 32 farms in Northeast Mississippi, 1944

Acres of cotton	Number farms	Acres per farm	Man hours per 500 lb. bale	Labor income
Below 10.0	9	6.1	152	$1,169
10 - 19.9	11	14.1	120	1,532
20 - 29.9	6	23.7	125	1,622
30 and over	6	57.5	158	1,906

Labor Efficiency

Using labor to the best advantage is one of the most important problems with which farm operators deal. Labor requirements are much greater for some enterprises than for others, and at the same time, the demands on all farms for labor is highly seasonal, particularly for crops. Labor requirements for crops constitute the largest cost item in their production. For cotton, this cost amounts to 60.5 percent of the total expenses of growing the crop. Labor requirements for corn, hay, and other crops were somewhat less, but still were the highest single cost item.

Work units per man available on farms. The amount of labor accomplished per man varied from farm to farm, and as the available man equivalent per farm increased, the units worked per man available decreased. (See table 20.) Also, as the available man equivalent per farm increased, the acres of cropland per farm increased. Farms with an average of 38 acres of cropland had an average of 1.63 man equivalent of labor available.

Since the amount of work accomplished per man available for work on the farm decreased as the size of business (measured by crop acres) increased, farmers operating large acreages should give more attention to using more efficiently the labor they have available under their management. It will be noticed that the acres of cropland per man did not vary much whether on a small farm or a large farm, yet the cost to produce an acre of cotton, or a pound of cotton, was greater as the size of farm business increased, and as the labor performed per man available decreased. The fact that larger farms had the most tenants, and since it was on these farms that labor was used less efficiently, this would tend to explain the unfavorable relationship of cropland per man and the greater cost of producing cotton on the larger farms.

Man hours per cow. The amount of labor used per cow ranged from 86 hours to 262 hours, and the average amount of man labor per cow was 145 hours for the 40 farms. (See table 21.) There was practically no relationship between hours used per cow and the amount of milk produced per cow. However, as man hours expended per cow, increased, the cost to produce 100 pounds of milk increased, and the labor return per hour decreased. Thus the labor used per cow should be kept at a minimum in keeping with the ability of the cow to produce milk. While feed is the most expensive cost item in the production of milk, the labor cost ranks next and much careful attention should be given to its use.

Table 20. Relation of man work units accomplished per man available[1] to various factors on 40 farms in Northeast Mississippi, 1944

Units worked per man available	Number farms	Average units worked per man available	Man equivalent	Acres cropland per farm	Acres cropland per man equivalent	Cost per acre of cotton	Total cost per lb. of lint	Man labor cost per pound of lint
						dollars	cents	cents
Less than 100	9	73	7.75	150	19.3	96	15.23	9.3
100 - 149	12	124	3.37	60	17.8	90	13.90	7.6
150 - 199	6	170	2.95	54	18.3	64	12.65	6.5
200 - 249	6	220	2.34	54	23.1	56	9.54	4.3
250 and over	7	310	1.63	38	23.3	48	11.43	5.2

[1] Man work units accomplished per man available was determined by dividing the total hours of productive work accomplished per farm by the man equivalent of labor found on the farm. The operator and man cropper tenants were considered as one man each available for 12 months of work. Family labor of the operator and family labor of the man cropper were converted to the equivalent of man labor.

Table 21. Man hours per cow related to various factors on 40 farm in Northeast Mississippi, 1944

Man hours per cow	Number farms	Hours per cow	Milk per cow	Cost per 100 lbs. milk	Labor returns per hour
		hours	pounds	dollars	dollars
Less than 100	5	86	3,920	$2.81	$0.73
100 - 149	19	125	4,332	3.07	0.56
150 - 199	12	167	3,575	3.70	0.30
200 and over	4	262	4,385	4.27	0.18
Total	40	145	3,931	3.34	0.47

Man hours per acre of cotton. The labor used per acre of cotton varied very much also. (See table 22.) Seven farms averaged only 77 man hours per acre while a like number of farms averaged 168 hours. As the man hours per acre increased, the pounds of cotton produced per acre increased, which was unlike the relationship of labor expended per cow and the milk produced per cow. However, as the pounds of cotton per acre and labor per acre increased, the cost to produce an acre of cotton increased. Unlike the application of labor to cows, as labor on cotton per acre increased, the cost to produce one pound of lint decreased and the labor return per hour increased up to 150 hours per acre and then decreased. Consequently, a farmer should be very careful about increasing the hours of labor used per cow and the labor used per acre of cotton above 150 hours under conditions similar to those on the 40 farms in Northeast Mississippi. The part of his total time as operator of the farm that should be devoted to the entire dairy enterprise is another problem and should be considered in the organization of the entire farm business.

Table 22. Man hours per acre of cotton related to various factors on 32 farms in Northeast Mississippi, 1944

Man hours per acre	Number farms	Average man hours per acre	Pounds of lint per acre	Cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
		hours	pounds	dollars	cents	dollars	cents
Less than 100	7	77	286	$57	16.5	$15	55
100 - 149	17	120	527	86	12.7	47	72
150 - 199	7	168	532	84	12.1	49	61
200 and over	1	218	573	91	13.5	52	45
Total	32	126	477	79	13.4	---	---

Rates of Production

Again the reader might be reminded that the 40 farms keeping records in 1944 were divided into three groups or types: (1) dairy-cotton farms where there was a relatively high number of milk cows per farm compared with acres in cotton; (2) cotton-dairy farms where the reverse of (1) above was true; and (3) dairy & cotton farms where the number of milk cows and acres in cotton per farm were about the same.

Types of farming and rates of production. In table 23 the types of farms were listed according to the pounds of milk produced per cow. Farms placing the most emphasis on cotton (cotton-dairy farms) kept cows which had the lowest production, or 3,400 pounds each. Farms where major emphasis was placed on the dairy enterprise (dairy-cotton farms) kept cows that produced an average of 4,000 pounds each. And farms which placed about the same emphasis on both dairy and cotton enterprises kept milk cows that produced an average of 4,400 pounds of milk each.

Table 23. Types of farming in Northeast Mississippi related to milk production per cow and other dairy factors on 40 farms, 1944

Type of farming	Number of farms	Size of herd	Milk per cow	Feed per cow		Man hours per cow
				Concentrates	Roughages	
	No.	No.	lbs.	lbs.	lbs.	hrs.
Cotton-dairy	12	12	3,413	1,242	2,858	158
Dairy-cotton	16	19	3,993	1,737	2,637	148
Dairy & cotton	12	10	4,392	1,314	2,319	124
All types	40	14	3,931	1,516	2,624	145

There was little relationship between the amount of milk produced per cow and the size of herd or the amount of concentrates fed per cow. Roughages fed per cow decreased as milk production increased and labor used per cow followed the same trend. It will be noticed that where there was a balance between number of cows and acres of cotton per farm that labor per cow was the lowest and milk production per cow was the highest. This made for more profitable milk production as shown in table 24.

Table 24. Types of farming in Northeast Mississippi related to milk production per cow, costs and returns on 40 farms in Northeast Mississippi, 1944

Type of farming	Number of farms	Milk per cow	Cost of feed and pasture per cow	Cost per cow per year	Cost of 100 lbs. milk	Profit per cow	Labor returns per hr. on cows
		lbs.	dollars	dollars	dollars	dollars	dollars
Cotton-dairy	12	3,413	$78	$148	$4.09	$—7	$0.22
Dairy-cotton	16	3,993	82	138	3.27	36	0.47
Dairy & cotton	12	4,392	68	133	2.83	42	0.61
All types	40	3,931	78	139	3.34	26	0.42

The cost to keep a cow for one year decreased by types of farming as the production per cow increased among the types. (See table 24.) Cost per cow was $148 on cotton-dairy farms, $138 on dairy-cotton farms, and $133 on dairy & cotton farms. Cost of producing 100 pounds of milk on dairy & cotton farms was the lowest, amounting to $2.83. The cost on dairy-cotton and cotton-dairy farms per 100 pounds of milk was $3.27 and $4.09, respectively. Farmers who placed major emphasis on producing cotton and minor emphasis on producing milk lost an average of $7 per cow. Dairy-cotton farms made a profit of $36 per cow, and dairy & cotton farmers made $42 on each cow kept. Likewise, the return per hour for labor used on milk cows was highest on dairy & cotton farms, amounting to $0.61. Labor return per hour for this enterprise on dairy-cotton and cotton-dairy farms was $0.47 and $0.22, respectively.

Milk per cow. A study of the dairy enterprise on farms in Northeast Mississippi finds, as in similar studies elsewhere, that low producing cows are not profitable and that as production per cow increases, profits per cow increase.

Cows producing less than 3,000 pounds of milk per year showed a loss of $15.75 per year, whereas cows producing an average of 5,438 pounds netted the farmer $44. (See table 25.) Only four farms had cows producing below 3,000 pounds. The yearly cost to keep a cow increased as the amount of milk per cow increased. (See table 26.) It cost $124 per year to keep a cow producing an average of 2,575 pounds, and it cost $175 to keep a cow that averaged 5,438 pounds. Thus the cost to produce approximately an extra 3,000 pounds of milk above the average production of the low producing cows was $51. That is the same as stating that farmers who kept cows that produced above 5,000 pounds, produced the last 3,000 pounds of milk at a cost of $1.70 per hundred.

Table 25. Milk produced per cow related to various factors on 40 farms in Northeast Mississippi, 1944

Pounds per cow	Number farms	Milk per cow	Feed cost per cow	Cost per 100 lbs. milk	Profit per cow	Labor return per cow
		lbs.	dollars	dollars	dollars	dollars
Below 3,000	4	2,575	$76	$4.51	$—15.75	$14
3,000 - 3,999	17	3,529	64	3.33	12.94	51
4,000 - 4,999	11	4,409	81	3.13	42.91	78
5,000 - 5,999	8	5,438	100	3.11	44.13	85
Total	40	3,931	$78	$3.34	$26.00	$62

Feed costs per cow increased as production increased, and the cost to produce 100 pounds of milk decreased. Profit per cow increased as production per cow increased. The cost to produce milk with a cow producing 5,000 pounds was 31 percent less than with a cow producing 2,500 pounds, and the labor return per cow was 500 percent greater for 5,500-pounds production cows.

Table 26. Milk produced per cow related to various factors on 40 farms in Northeast Mississippi, 1944

Pounds per cow	Number farms	Average pounds per cow	Pounds of concentrates per cow	Pounds of roughage per cow	Man hours per cow	Size of herd	Yearly cost per cow
		lbs.	lbs.	lbs.	hours	no.	dols.
Below 3,000	4	2,575	1,425	3,097	147	22	$124
3,000 - 3,999	17	3,529	978	2,449	148	13	126
4,000 - 4,999	11	4,409	1,633	2,793	137	14	147
5,000 - 5,999	8	5,438	2,022	2,885	145	14	175
Total	40	3,931	1,516	2,624	145	14	$139

Concentrates fed per cow increased as production increased. Likewise, the cost to keep a cow for one year increased. There was no relationship between production per cow and man hours used per cow.

Cost to produce 100 pounds of milk was $4.51 for farmers having cows that produced 2,575 pounds annually. Whereas, the cost was $3.11 per 100 pounds on farms having cows that averaged 5,438 pounds. Labor returns per hour spent on milk cows increased as the milk produced per cow increased. Again, it might be pointed out that though the farmers with the lowest producing cows made a minor profit per cow, they had a labor return of $14 per cow. Assuming the farmer could not use his labor more profitably on some other enterprise, and though his cows were low producers, his cows did pay all expenses other than labor and gave the farmer a return of $14 per head as part payment for the labor he spent on them during the year. Labor return per cow was $85 where cows averaged producing above 5,000 pounds of milk.

Milk per cow by types of farming. The highest producing cows were not found on farms that placed major emphasis on keeping milk cows, but were found on the dairy & cotton type of farm. (See table 27.) Concentrates fed per cow producing milk at various levels varied considerably among the three types of farms. However, the general trend was an increase in the feeding of concentrates per cow as the production increased. There was less relationship of this trend among cotton-dairy farms.

It will be noticed that on cotton-dairy farms it was only when milk production reached the 5,000-pound mark that these farmers received a profit per cow. The cost of 100 pounds of milk increased as production per cow increased for dairy & cotton farms, which is inconsistent with each of the other types of farms and when all 40 farms are likewise considered. This may be due to the feeding of considerably more concentrates to the cows producing above the 3,000-pound level on the dairy & cotton farms. Also, it is quite possible for the cost to produce 100 pounds of milk to increase as production increased, but at a lesser rate and thereby show a favorable return.

Table 27. Milk per cow by types of farming related to various factors on 40 farms in Northeast Mississippi, 1944

Pounds per cow	Number farms	Average pounds per cow	Concentrates per cow	Yearly cost per cow	Cost per 100 lbs. milk	Profit per cow	Labor return per hour
		pounds	pounds	dollars	dollars	dollars	dollars
		Dairy-cotton farms					
Below 3,000	2	2,600	1,626	$115	$4.08	$4.00	$0.19
3,000 - 3,999	5	3,500	919	120	3.21	15.00	0.32
4,000 - 4,999	6	4,317	1,321	136	2.92	56.00	0.72
5,000 - 5,999	3	5,133	2,720	165	3.10	41.00	0.57
Average	–	4,000	1,737	138	3.27	36.00	0.47
		Cotton-dairy farms					
Below 3,000	2	2,550	1,223	133	4.94	—35.00	—0.01
3,000 - 3,999	7	3,471	1,164	142	3.82	— 4.00	0.30
4,000 - 4,999	1	4,500	2,521	240	5.05	—17.00	0.15
5,000 - 5,999	2	5,650	1,218	176	3.04	42.00	0.63
Average	–	3,400	1,242	148	4.09	— 7.00	0.22
		Dairy & cotton farms					
Below 3,000	0	-------	-------	-----	-----	-----	---
3,000 - 3,999	5	3,640	776	110	2.76	53.00	0.57
4,000 - 4,999	4	4,525	1,879	140	2.97	79.00	0.61
5,000 - 5,999	3	5,600	1,861	185	3.15	92.00	0.64
Average	–	4,400	1,314	133	2.83	42.00	0.61
Average all groups	–	3,900	1,516	139	3.34	26.00	0.42

Pounds of cotton per acre. The production of cotton per acre ranged from 196 pounds to 837 when considering all farms. Seventy-five percent of all farms growing cotton had an average yield above 400 pounds per acre and 44 percent of the farms producing cotton had a yield above 500 pounds. (See table 28.)

As production per acre increased, man hours and total cost per acre increased. Likewise, profit per acre and labor return per hour increased. The farmers who produced above 770 pounds per acre received nearly one dollar per hour for their labor used on cotton.

Table 28. Pounds of lint per acre related to various factors on 38 farms in Northeast Mississippi, 1944

Pounds of lint per acre	Number farms	Average pounds per acre	Man hours per acre	Total cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
		pounds	hours	dollars	cents	dollars	cents
Below 300	5	242	76	47	16.0	15	48
300 - 399	3	332	96	67	16.7	15	53
400 - 499	10	436	137	72	12.6	37	62
500 - 599	7	573	139	92	12.7	51	76
600 - 699	5	616	138	99	12.3	58	87
700 plus	2	798	161	114	10.9	83	93

Pounds of cotton per acre by types of farming. All types of farming showed an increase in man hours required per acre, total costs per acre, and profit per acre as the pounds of cotton produced per acre increased. (See table 29.) It was previously pointed out that man labor was the greatest cost item in the production of cotton amounting to 60 percent of total costs. This cost is shown by types of farming as related to pounds of cotton per acre for land, man labor and other factors.

Where there was much emphasis placed on producing cotton (cotton-dairy farms), both land and labor costs increased as production increased up to where the average production was 604 pounds per acre, and then decreased as production went higher. This relationship was not obtained for the other types of farms. A larger number of cases might have given the same relationship. The lack of a sufficient number of farms in each class interval or grouping, should be considered before attempts are made to draw conclusions.

The total cost to produce one pound of lint cotton on dairy & cotton farms decreased rather definitely as the yield per acre increased. This trend was not as consistent on the other two types of farms. The relation between increased yields per acre and labor returns per hour spent on cotton was fairly direct.

Table 29. Pounds of cotton per acre by types of farming related to various factors on 40 farms in Northeast Mississippi in 1944

Pounds per acre	Number farms	Average pounds per acre	Man hours per acre	Cost per pound		Cost per acre	Cost per pound	Profit per acre	Labor returns per hr.
				Land	Man labor				
		pounds	hours	cents	cents	dols.	cents	dols.	dols.
				Dairy-cotton farms					
Below 300	4	241	82	1.55	6.57	45	15.3	17	.45
300 - 399	–	—	—	—	—	—	—	—	—
400 - 499	3	442	172	.26	7.40	72	12.0	39	.49
500 - 599	1	582	100	.19	3.09	101	13.7	41	.63
600 - 699	–	—	—	—	—	—	—	—	—
700 plus	–	—	—	—	—	—	—	—	—
Average	–	334	112	.81	6.55	57	13.3	27	.49
				Cotton-dairy farms					
Below 300	–	—	—	—	—	—	—	—	—
300 - 399	1	337	76	.36	7.62	68	16.1	16	.64
400 - 499	5	433	129	.39	7.67	73	13.1	35	.62
500 - 599	3	577	170	.90	9.05	99	14.2	45	.70
600 - 699	1	604	144	.92	9.81	120	15.7	37	.77
700 plus	2	799	161	.33	6.44	114	10.9	83	.93
Average	–	505	151	.50	8.45	86	13.5	38	.61
				Dairy & cotton					
Below 300	1	242	54	.94	8.39	58	18.6	6	.59
300 - 399	2	330	105	.33	9.03	67	17.0	14	.47
400 - 499	2	433	104	.39	7.53	70	12.3	40	.80
500 - 599	3	567	120	.28	5.85	82	10.9	60	.87
600 - 699	4	620	136	.38	7.06	94	11.5	63	.90
700 plus	–	—	—	—	—	—	—	—	—
Average	–	520	120	.37	7.27	84	12.4	48	.81
Average all groups	–	490	141	.50	8.04	83	13.3	39	.63

Dairy-cotton farmers received less for their labor when using it on cotton than did cotton-dairy and dairy & cotton farms. Low yields were partially responsible for this. Dairy & cotton farms received a labor return of 81 cents; cotton-dairy farms, 61 cents; and dairy-cotton farms, 49 cents for each hour spent in producing cotton. It should be noticed that the return per hour for labor used producing cotton was greater for those farms where there was a fairly well balanced emphasis on dairying and cotton. Likewise, this type of farming produced cotton at the lowest cost and received the highest profit per acre of cotton raised.

Types of Farming

The yield of cotton per acre varied considerably on the 32 farms producing it. Table 30 shows this variation by types of farming. Cotton-dairy farms grew four times the acreage of cotton as was grown on dairy-cotton farms and a little more than three times the amount grown on dairy & cotton farms. The yield per acre was slightly more than a bale per acre on both cotton-dairy and dairy & cotton farms, whereas the yield was only two-thirds bale per acre on dairy-cotton farms.

Table 30. Types of farming related to various factors in producing cotton on 32 farms in Northeast Mississippi, 1944

Type of farming	Acres per farm	Yield 500-lb. bales	Cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
	number	number	dollars	cents	dollars	cents
Dairy-cotton	9.1	6.1	57	13.3	27	49
Cotton-dairy	39.9	40.3	86	13.5	38	61
Dairy & cotton	12.1	12.6	84	12.4	48	81
All types	21.8	21.3	83	13.3	39	63

The cost of producing a pound of cotton varied little between types of farms, but varied considerably between individual farms. The cost per pound on dairy-cotton and cotton-dairy farms was 13.3 and 13.5 cents, respectively. The cost to produce a pound of cotton on dairy & cotton farms was 12.4 cents, or one cent less than for the other farm types. The range in cost to produce a pound of cotton on the 32 farms was from 6.67 cents to 21.16 cents. Seventy-five percent of the farms produced cotton at a cost range from 10 to 16 cents per pound with an average cost of 13.3 cents for all farms.

Labor returns per hour spent on cotton averaged 63 cents for the 32 farms. Low yields per acre undoubtedly account for the low labor return on dairy-cotton farms. On the other hand, yields were approximately the same for cotton-dairy and dairy & cotton farms. Yet, the returns per hour of labor on dairy & cotton farms was 33 percent higher than on dairy-cotton farms. This difference was due largely to the fact that the cotton-dairy farms used 31 hours more labor per acre, or 26 percent more than was used by dairy & cotton farms.

Combination of Enterprises

The combination of crops and animal enterprises for 39 farms and for the three types of farming in Northeast Mississippi are shown in table 31. The most important crop enterprises were cotton, corn, and hay. Corn and hay were grown for livestock feed. Hay was a cash crop on two farms.

Cotton and milk cows are the major income enterprises on farms in Northeast Mississippi, and anything affecting these two enterprises plays an important role in determining the well-being of farmers in this area. The most profitable combination of cotton and milk cows and contributing enterprises constitutes a question that has not been satisfactorily answered in the area under study.

Generally, a farmer receives the most of his income from the farm enterprise on which he spends the most of his labor. The average farm had 14.2 milk cows on which 205 ten-hour days of productive work were spent. Also, farms producing cotton had an average of 21.8 acres in that crop on which 307 ten-hour days of productive work were spent. Thus 49 percent more labor was used on the cotton enterprise than on the dairy enterprise for all farms.

Table 31. Combination of enterprises by types of farming and as related to labor income on 39 farms in Northeast Mississippi

Enterprise	Number farms reporting enterprise	Average for 39 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton	Labor income Upper 1/3 all farms	Labor income Lowest 1/3 all farms
				acres or head			
Crops:							
Cotton	32	13.8	4.4	30.0	12.1	19.6	7.6
Corn	37	19.5	12.2	33.0	16.9	28.5	17.2
Oats	14	5.6	5.5	3.7	7.3	12.8	2.3
Johnson grass hay	8	3.9	5.6	5.6	.0	——	——
Lespedeza hay	11	2.4	3.8	2.1	.9	——	——
Soybeans, hay	21	8.0	5.8	15.7	4.5	——	——
Other hay	18	5.2	3.8	4.6	7.5	——	——
Total hay	–	19.5	19.0	28.0	12.9	23.5	19.5
Silage	6	0.4	0.5	0.6	0.6	0.2	0.2
Other crops	–	2.5	0.5	3.4	3.8	1.1	0.4
Crop acres[1]	–	61.3	42.1	98.7	53.6	85.7	47.2
Animals:							
Dairy cows	40	14	19.0	10	10	16	13
Other cattle	39	11	13	8	10	13	9
Hogs	34	9	8.0	9	9	11	8
Hens	40	80	53.0	116	84	90	58
Workstock	40	4	3.0	5	4	5	3

[1] Crop acres include double cropped acres.

All farms produced milk for the market. Only 32 farms produced cotton. Therefore, for eight farms, the sale of milk was the only source of cash income except for miscellaneous sales of surplus stock, eggs and feed, which contributed considerably to labor income on some farms. All of the farms sold surplus livestock such as calves and heifers, eggs, hens, hogs, and a few sold some hay and corn. Labor income for eight farms in the dairy-cotton farm group not producing cotton was 73 percent of average labor income for the entire group of dairy-cotton farms. In other words, farms including cotton in their farm program along with milk cows in this type of farming had a larger labor income. However, profit per herd on the eight farms depending on cows for their cash income was $883, or 33 percent above the average herd profit of $665 for dairy-cotton farms; and more than twice as much profit per herd as for the 40 farms, which was $370.

Type of farming related to enterprise profits. Farms placing major emphasis on cotton lost $7 per cow annually and $89 per herd. But they made a profit of $38 per acre on cotton and a profit of $1,516 on the cotton enterprise. (See table 32.) Farms placing about the same emphasis on both milk cows and cotton received the greatest return per cow and per acre of cotton. Labor income was slightly higher than for the other types of farming—dairy-cotton and cotton-dairy. Since the dairy & cotton farms were slightly smaller than dairy-cotton farms, and only about 50 percent as large as cotton-dairy farms, it appears that much attention should be given to the desirability of organizing farms so that major emphasis is placed on both the cotton and dairy enterprises in the area of this study.

Table 32. Types of farming related to enterprise profits in Northeast Mississippi, 1944

Type of farming	Profit on Dairy enterprise	Profit on Cotton enterprise	Profit per Milk per cow	Profit per Acre of cotton	Labor income
Dairy-cotton	$665	$ 246	$36	$27	$1,400
Cotton-dairy	— 89	1,516	— 7	38	1,426
Dairy & cotton	435	581	42	48	1,439
All farms	370	850	26	39	1,419

Weather conditions were very favorable in Northeast Mississippi to cotton production in 1944 and only fair for feed crops and pastures. These conditions should be considered when making an appraisal of the results of this report. The fact that cotton-dairy farms with a larger investment did not make a larger labor income was due to the loss they sustained on their dairy herds and to using farm labor less efficiently.

Combination of enterprises on high and low income farms. A comparison of enterprises on farms found in the upper one-third labor income group ($2,444) and the lowest one-third labor income group ($416) of the farms under study is also given in table 31. Crop acres were 85.7 for the upper income group and 47.2 acres for the low income group with an average of 61.3 acres for all farms. Thus, the size of business looms up as an important factor affecting income. Cotton acreage in the upper one-third income group was more than twice as great as in the lowest one-third income group, whereas milk cows were only three less in the low income group than in the upper income group. Forty-one percent of the crop acreage on the low income farms was in hay and 27 percent was in hay on the upper income group.

Combination of enterprises on high and low cost farms. The combination of enterprises on farms producing cotton and milk at the highest and lowest costs per pound of lint and per 100 pounds of milk are shown in table 33. The 10 farms producing cotton at the lowest cost, or 9.44 cents per pound, had 14.3 acres in cotton, and the 10 high-cost farms—16.99 cents per pound—had 16.3 acres in cotton. The difference in acreage was not significant. However, acres of cotton produced on the highest-milk-cost farms ($4.51 per 100 pounds) were twice as many as were found on the 10 farms producing milk at the lowest cost, or at $2.30 per 100 pounds.

The difference in the emphasis placed on milk cows and other livestock on high and low cost farms for both cows and cotton (table 33) was of little significance, which means that the difference in milk costs due to other factors such as the capacity of cow, feeding practices, time of calving, pasture per cow, efficient use of labor, and emphasis placed on other enterprises. The fact that the 9 farms producing milk at the highest cost had twice the acreage of cotton as was found on the 10 farms producing milk at the lowest cost, bears out earlier findings that milk was produced less efficiently on farms giving major emphasis to cotton.

Table 33. Combination of enterprises on 39 farms related to combination of enterprises on high and low cost farms in Northeast Mississippi, 1944

Enterprise	Average for 40 farms	10 farms producing cotton at lowest cost (9.44 cents)	10 farms producing cotton at highest cost (16.99 cents)	10 farms producing milk at lowest cost ($2.30)	9 farms producing milk at highest cost ($4.51)
			Acres or head		
Crop:					
Cotton	17.2	14.3	16.3	11.4	21.0
Corn	21.8	18.9	22.6	19.9	29.7
Oats	6.8	.7	10.3	1.0	4.0
Johnson grass hay	10.7	7.9	0.3	......	6.6
Lespedeza hay	2.4	0.9	1.3	0.9	6.0
Soybean hay	8.3	4.4	6.6	1.8	11.7
Other hay	5.2	6.9	7.4	3.7	5.4
Silage	.4	0.3	0.6	.3	0.2
Animals:					
Dairy cows	14	10.7	12.2	11.0	13
Other cattle	11	9.4	10.5	7.6	11
Hogs	9	8.9	8.3	13.3	7
Hens	80	103.9	95.4	66.5	90
Workstock	4	2.8	4.2	3.9	4
Lint per acre, lbs.	490	507	393	414	524
Milk per cow, lbs.	3931	4260	3890	4470	3811

The number of milk cows on the 10 farms producing cotton at the lowest cost and the 10 farms producing cotton at the highest cost were practically the same. Likewise, acres per farm in cotton were about the same. However, the 10 farms producing cotton at the lowest cost, produced an average of 114 pounds per acre more than on the 10 farms producing cotton at the highest cost. The farms producing cotton at the lowest cost kept cows that produced more milk by 370 pounds than was the production per cow on farms producing cotton at the highest cost.

The 10 farms producing milk at the lowest cost kept cows that averaged 4,470 pounds of milk each, whereas the average production per cow on the 9 highest cost farms was 3,811 pounds—an annual difference of 659 pounds. On the other hand, the yield of cotton was greatest per acre on farms with the highest milk production costs. This again points out the fact that milk was produced less efficiently on farms placing the most emphasis on cotton. Also, it has been shown that labor is used less efficiently on farms with a large acreage of cotton.

Soil Fertility

Detail soil maps for each of the 40 farms in this study were furnished by the Soil Conservation Service of Mississippi and the Bureau of Plant Industry. These maps were used to study in detail the soil types on each farm. A staff member of the Experiment Station Soils Department assisted in this work by making a visit to each farm to study the types of soils with special emphasis on the fertility and adaptability of crops to the soils on which they were being grown. Farms were then classed as high, medium, and low in fertility for the purpose of finding relationships between farms of different fertility levels and the costs of production and income.

Soil fertility related to costs and returns. Half of the farms in the Black Prairie Area were classed high in fertility. One-half of the farms in the Northeast Highland Area were low in fertility, and 85 percent of the farms in the Pontotoc Ridge Area also were classed low in fertility.

For the areas as a whole, the cost to produce one pound of cotton increased as soil fertility decreased. (See table 34.) The difference in costs between farms of high fertility and low fertility was approximately two cents per pound. With a market price of 20 cents for cotton, a spread of 2 cents per pound amounts to $10 per bale. Interest at 5 percent on an investment of $200 amounts to $10. Consequently, a farmer can afford to pay considerably more for land of high fertility when purchasing land for the purpose of growing cotton. The rate of cotton production was greater on farms of high soil fertility, as would be expected. This, of course, was a major factor in influencing the smaller cost of producing a pound of cotton on these farms.

Table 34. Relation of soil fertility to the cost of producing cotton and income on 32 farms in Northeast Mississippi, 1944

Soil fertility	Number farms	Number of farms in			Cost to produce one lb. of lint	Return per hour of labor	Labor income per farm	Production per acre
		Prairie Black	N. E. Highland	Pontotoc Ridge				
					cents	cents	dollars	pounds
High	13	11	1	1	12.58	70	1,712	508
Medium	5	3	2	0	11.97	63	1,970	436
Low	14	4	3	7	14.67	68	1,038	462

Soil fertility related to various factors. The foregoing soil fertility cost relationship for the 32 farms were the same for the Black Prairie Area except that the difference between cost of producing a pound of cotton on high and low fertility farms was greater. (See table 35.) In the Pontotoc Ridge and Northeast Highland Areas, the same general relationship existed. However, the value of these findings is limited by the few farms in this study located in the Northeast Highland Area and in the better grades of land in the Pontotoc Ridge Area.

Table 35. Relation of soil fertility to the cost of producing cotton and income on 32 farms in 3 soil areas of Northeast Mississippi, 1944

Soil fertility	Number farms	Cost of one pound of lint	Labor return per hour	Labor income	Lint produced per acre
		cents	cents	dollars	pounds
			Black Prairie		
High	11	12.78	65	1,798	493
Medium	3	12.50	54	1,877	349
Low	4	16.35	53	1,228	374
			Northeast Highland		
High	1	13.86	94	1,807	633
Medium	2	11.19	79	1,299	566
Low	3	11.20	86	1,546	677
			Pontotoc Ridge		
High	1	9.08	90	668	552
Medium	0	-------	---	3,684	-----
Low	7	15.9	68	796	421

Farms high in fertility produced an average of 508 pounds of lint cotton per acre, but both medium and low fertility farms produced well above 400 pounds per acre. (See table 36.)

Profit per acre of cotton decreased as soil fertility decreased. Farms of low fertility spent more for fertilizer per acre than did farms of medium fertility, yet received less profit per acre. Labor income was inconsistent in its relationship to soil fertility; however, labor income on farms of low fertility was much less than labor income on farms of medium and high fertility.

Table 36. Relation of soil fertility to various factors on 32 farms growing cotton in Northeast Mississippi, 1944

Soil fertility	Number farms	Pounds cotton per acre	Cost per pound of lint	Fertilizer cost per acre of cotton	Profit per acre	Labor income	Farm investment per acre
			cents	dollars	dollars	dollars	dollars
High	13	508	12.58	6.97	45	1,712	76
Medium	5	436	11.97	3.85	40	1,970	74
Low	14	462	14.67	5.57	37	1,038	63

Soil Crop Adaptation

Growing a crop on the type of soil to which it is best adapted usually gives the highest labor returns. Progressive farm operators give much thought to placing crops in their farm layouts so that this relationship exists. Table 37 shows the relationship of the adaptation of crops to soils on the 40 farms in this study. On 22 farms the adaptation of crops to soils on which they were grown was "good"; on 14 farms, "fair"; and on 4 farms it was "poor". The adaptation of crops to soils on the farm as a whole was used as a basis for the above classification.

Table 37. Soil crop adaptation related to various factors on 40 farms in Northeast Mississippi, 1944

Soil crop adaptation	Number farms	Lint cotton		Corn		Return per hour of labor on cotton	Labor income
		Per acre	Cost per pound	Per acre	Cost per bushel		
		lbs.	cents	bu.	dols.	cents	dols.
Good	22	517	12.42	26	0.94	73	1,709
Fair	14	407	15.05	26	1.10	61	1,076
Poor	4	424	15.17	14	1.41	54	1,033

The rate of production was highest where soil crop adaptation was good. It cost 12.42 cents to produce a pound of lint cotton where adaptation was good, 15.05 cents where it was fair, and 15.17 cents where adaptation was poor. The cost to produce a bushel of corn was 94 cents where soil crop adaptation was good, $1.10 where it was fair, and $1.41 where soil crop adaptation was poor. The cost of producing cotton per pound was 23 percent greater on farms with poor soil crop adaptation than on farms when the soil crop adaptation was good. It cost 50 percent more to produce corn on farms where the soil crop adaptation was poor than where the soil crop adaptation was good. Also, it will be observed that labor return per hour spent on cotton was 73 cents where soil crop adaptation was good, 61 cents where it was fair, and 54 cents on farms where it was poor. Labor income was highest on farms where soil crop adaptation was good and lowest on farms with poor soil crop adaptation.

Milk Production by Seasons

Seasonal fluctuation of the production of milk was tremendously great on a large majority of the farms. This variation in the amount of milk produced per cow from season to season, or from winter to summer, is due primarily to the seasonality of pasture production and breeding practices as well as to feeding practices. Since few farmers grow winter pastures and with many feeding lightly in the winter, milk production is piled up from April to September. In fact, 64 percent of the milk produced by 571 cows on 40 farms was produced from April to September, or in just 50 percent of the year. Figure 2 shows the monthly trend of total milk sold on the 40 farms as well as the trend for the monthly butterfat test.

This great fluctuation in milk production during the year affects very little the efficient operation of the farm business as they are now organized, since the labor spent on a cow varies only a small amount from season to season. On the other hand, milk processing plants are faced with a very difficult problem. Since their equipment, which represents a relatively large investment, is used only for processing whole milk, these plants are forced to carry equipment and labor necessary for capacity production for less than 6 months during the year and then operate much under capacity for a large portion of the year. Should the milk plants in the area shut down during their slack season, there would be no market outlet for farmers producing milk, which would be disastrous to the dairy business. Yet most dairy farmers permit their cows to virtually shut down in production during the winter months and expect milk plants running at one-fourth capacity or less to continue operation.

Seasonal production related to costs and returns. Thirteen farms milked cows that produced for sale during the months of January, February, and March, only 146 pounds each per month. (See table 38.) That was less than ½ gallon daily per cow. For the 40 farms as a whole, the average daily amount sold per cow in the months of January, February, and March was only 7.3 pounds of milk. That was less than 1 gallon per day. Cows producing above 5,000 pounds for sale during the year averaged 11.6 pounds of milk per day in the first quarter of the year and reached a production of slightly less than 2 gallons per day in the months of July, August, and September

Table 38. Pounds of milk sold monthly per cow in each quarter of year and costs and labor returns for 571 cows on 40 farms in Northeast Mississippi, 1944

Pounds of milk sold per cow	No. of cows	No. of farms	Pounds sold monthly per cow				Cost per 100 lbs. milk	Labor returns per hr. on cows
			January-March	April-June	July-September	October-December		
Below 3,000	198	13	146	276	262	151	$3.88	$0.25
3,000 - 3,999	227	18	203	410	380	181	2.99	0.56
4,000 - 4,999	112	7	341	461	430	272	3.41	0.58
5,000 - 5,999	34	2	350	471	485	392	2.99	0.64
Total	571	40	219	377	355	201	2.83	0.42

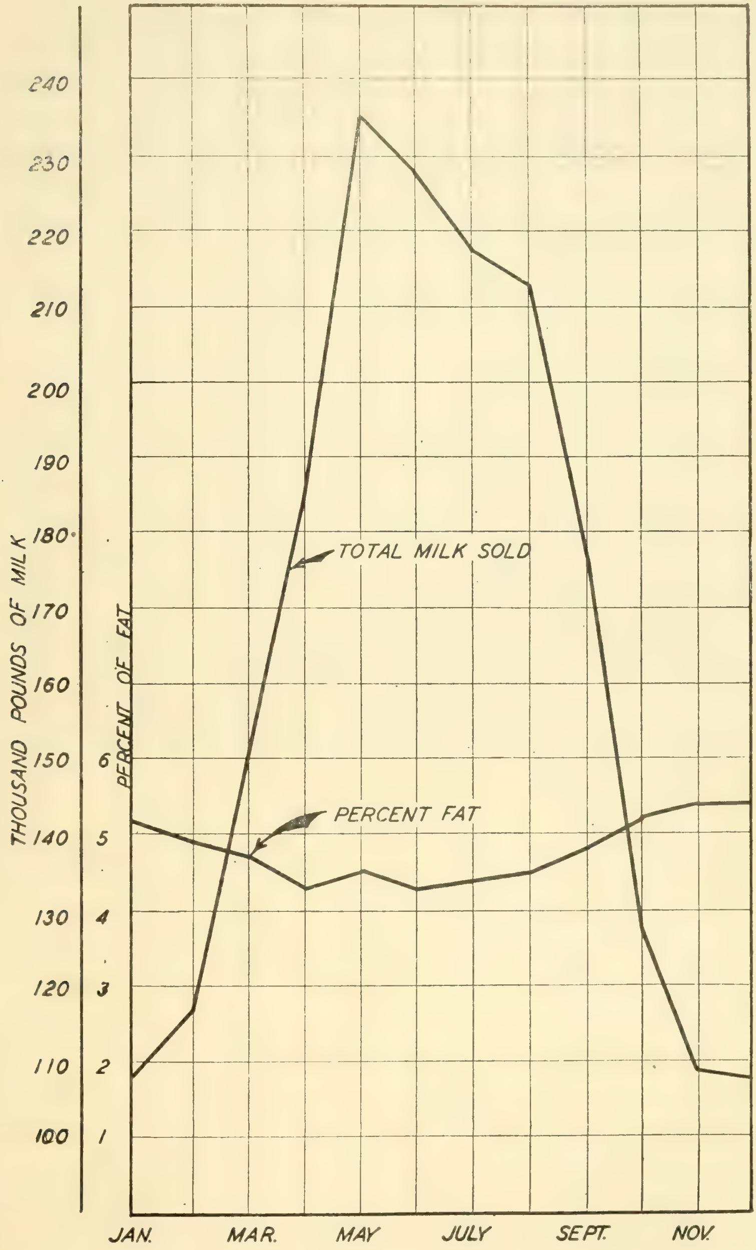

Figure 2. Total milk sold and butterfat test by months for 571 cows on 40 farms in Northeast Mississippi, 1944.

—their highest producing quarter. Milk sold per cow, on the average, was 1.3 pounds per day less than was produced. This amount was consumed by the family or by calves. Cows producing less than 5,000 pounds of milk sold per year reached their peak of daily production in the second quarter of the year.

Figure 3 shows the trend of milk sold monthly per cow in each of the quarters of the year, as well as the labor return per hour for labor used on milk cows. Increase in production for the second quarter of the year was rather abrupt. The increase for cows producing below 3,000 pounds sold annually was approximately 90 percent, and over 100 percent for cows producing from 3 to 4 thousand pounds. This increase in the springtime was not as great for cows above the 4,000-pound mark. It is shown further that production per cow declined gradually from the second quarter to the third quarter, except when more than 5,000 pounds were sold per cow, and then dropped precipitously in the fourth quarter, reversing the movement in the spring months.

Figure 2 shows the monthly trend of total milk sold on the 40 farms as well as the trend for the monthly percent butterfat test. This monthly trend of milk sold coincides closely with pasture conditions. It should be noticed that cows producing from 340 to 350 pounds of salable milk monthly in January, February, and March, which is approximately 1.3 gallons per day, gave a labor return of more than twice as much per hour as was given by cows producing an average of 146 pounds per month.

Cows producing below 3,000 pounds of market milk per year and dropping very low in winter production, produced milk at a cost of $3.88 per 100 pounds with a labor return of $0.25 per hour. Cows producing from 4,000 to 5,000 pounds of market milk annually produced it at a cost of $3.41 per 100 pounds and gave a labor return of $0.58 cents per hour.

Farm Practices

Practices followed by farmers in operating their businesses are very important in the effect upon costs and income and the profitableness of the farm as a whole. Farmers often follow different practices and get practically the same results. If the results are good, then both practices may be good under the given conditions. However, if farmers are using poor practices, results obtained very seldom give pleasure and profit in the business.

Practices followed in feeding cows varied from farm to farm giving varying results. Records of these methods of feeding show that the combination of feeds and the capacity of cows to convert feed materials into milk play a greater part in profitable milk production than do mere quantities of feed. A few farmers feed for winter production and may feed to keep their cows alive until spring grass comes. Others feed for winter production and then practically quit feeding when the cows begin to get a few nibbles of grass in the spring. A few dairymen are beginning to provide winter grazing by planting oats, or other winter crops. All indications point to the need for a more detailed study of feeding practices by dairymen under actual farm conditions.

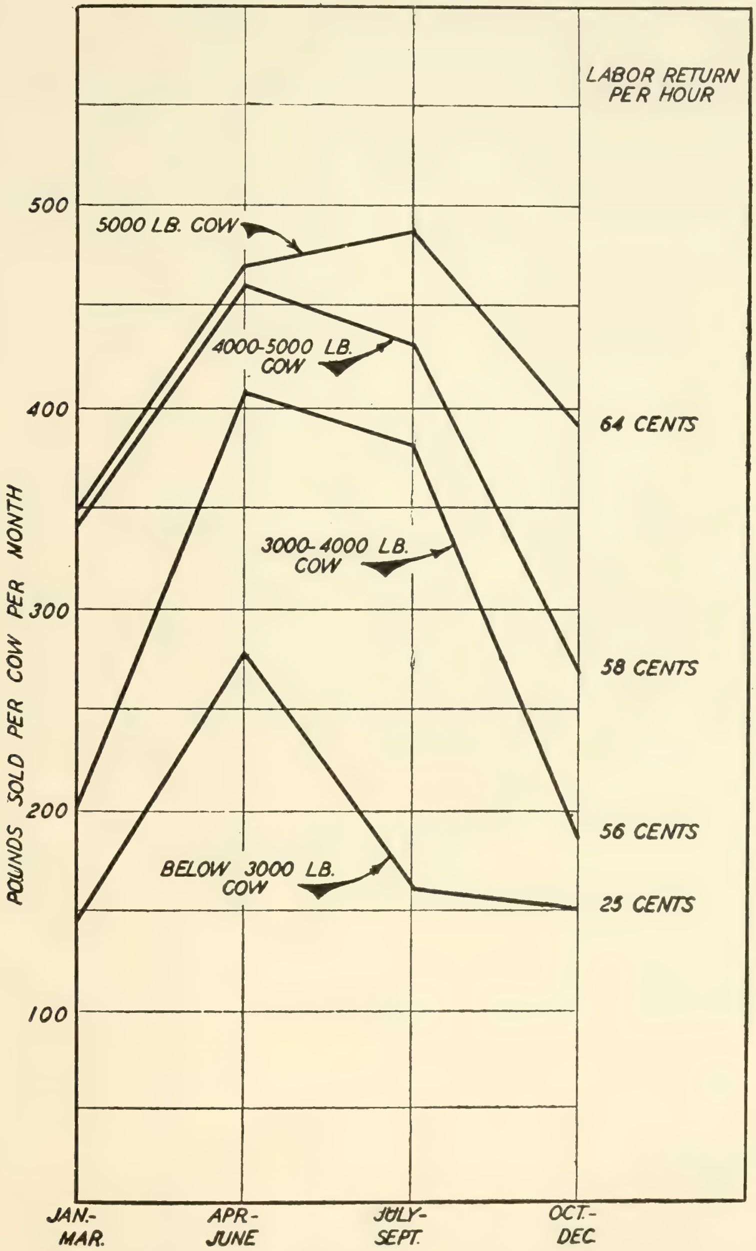

Figure 3. Pounds of milk sold monthly per cow in each quarter of year and labor return per hour spent on cows producing different amounts of milk on 40 farms in Northeast Mississippi, 1944.

Producing milk for the winter market. Farmers milking cows that have a relatively high production in the winter when compared with those having a low production in the winter months, produce milk more cheaply and receive the largest return per cow. Line graphs of monthly production per cow when production was low and when relatively high in winter months are shown in figure 4.

Low winter producers had an average production of only 121 pounds in January, or 4 pounds per day. Their production was 165 and 158 pounds, respectively, for November and December, and 160 pounds for February. Their peak production of 425 pounds per month was reached in May. Production for low winter producers almost doubled in the 2-month period of September and October.

When winter production was relatively high, the average production per cow for January was 392 pounds, or 13 pounds per day. Low winter producers gave less than ½ gallon of milk per day, which indicates that the low producers were practically dry.

The yearly per day cost of keeping the average cow on the five farms where production of milk was low in winter months was $0.29. The yearly per day market value of the milk produced on these same farms was 3.72 cents per pound. With a cow producing 4 pounds per day, the daily value of milk per cow was 14.88 cents. Thus the average cow on the five farms where winter production was low was kept at a loss of about 15 cents per day during January. The loss per day would have been greater if the daily cost had been determined for the month of January. This unfavorable situation continued through February and on into the spring months until production increased sufficiently to equal cost of production. In the fall months, production dropped to the point where daily costs per cow for the months of October, November, and December were greater than the daily value of milk produced.

On the other hand, the yearly per day cost to keep the average cow on the five farms where production of milk was relatively high per cow in the winter months was 39.7 cents. The yearly per day market value of the milk produced on those same farms was 3.85 cents per pound, and with a cow producing 13 pounds of milk per day in January, the daily value of milk produced was 50.1 cents. Therefore, the average cow on the five farms where winter milk production

Table 39. Rate of production in winter related to feed, labor, cost, and profit

Item	Low winter production per cow	Relatively high winter production per cow
Cows per herd	14	12
Production per cow, lbs.	3,227	4,960
Concentrates per cow, lbs.	865	1,543
Roughage per cow, lbs.	2,335	2,039
Man hrs. per cow, hrs.	163	123
Feed and pasture costs per cow, dollars	53	77
Cost of cow per year, dollars	112	144
Profit per cow, dollars	16	54
Labor return per hour, cents	35	72
Cost per 100 lbs. milk, dollars	3.29	2.76

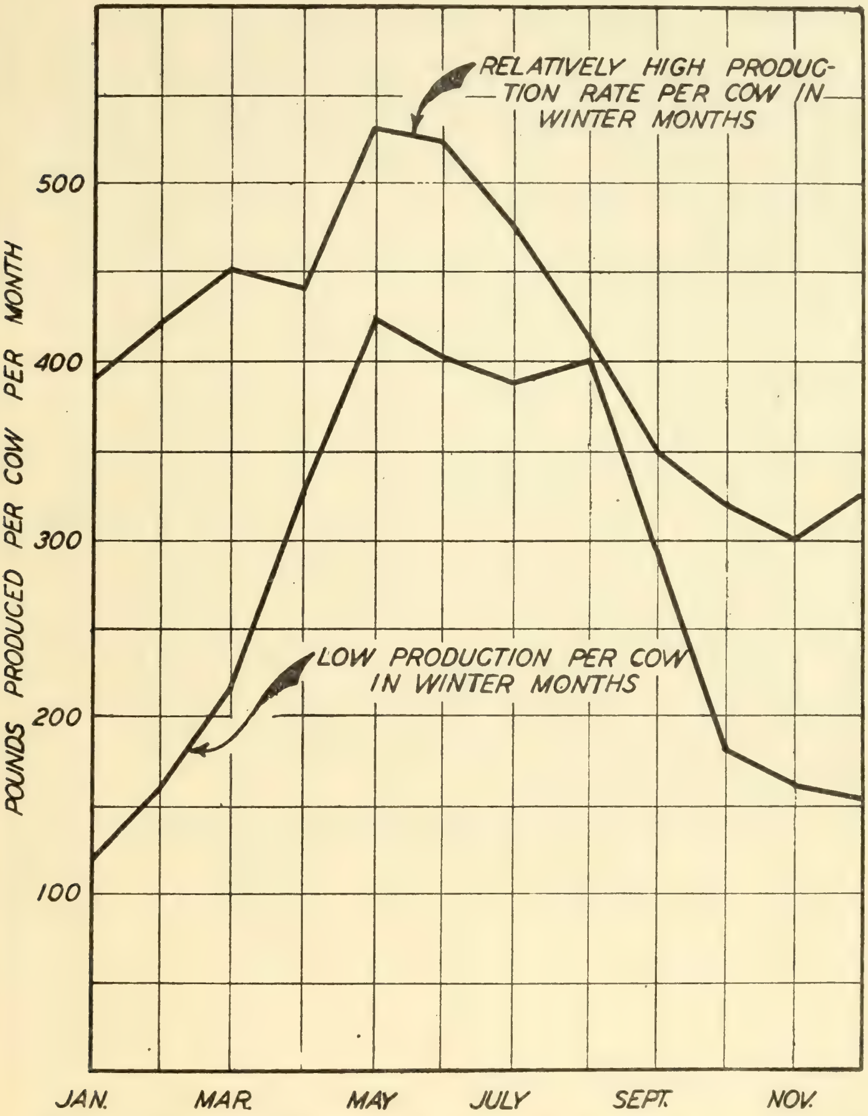

Figure 4. Five farms with very low winter milk production per cow, and five farms with relatively high winter production per cow related to various factors, 1944.

Milk production per month for 571 cows increased 117 percent from January to May and decreased 50 per cent from July to November. This fluctuation in milk makes it very difficult for milk plants to operate efficiently throughout the year. Also, it creates a problem for milk truckmen. Since more winter production usually results in higher profit per cow, farmers need to consider more seriously the problem of seasonal production.

was relatively high was kept at a gain of 10.4 cents per day. This gain was above all costs including labor.

On farms where winter production per cow was low, the amount of milk produced per cow during the year was 1,733 pounds less than the amount produced by cows relatively high in winter production. (Figure 3.) Concentrates fed per cow were considerably less on the low-winter production farms. They did feed, however, a little more roughage per cow than was fed on high winter production farms. Profit per cow was three times greater and labor returns per hour used on cows was twice as great on farms where winter production per cow was relatively high. Also, the cost to produce 100 pounds of milk was 53 cents less on those farms. The foregoing shows that it was much more profitable to keep cows producing relatively high in the winter months as well as during summer.

Cotton production with and without sharecroppers. Thirty-two of the 40 farms on which records were kept produced cotton. Eight of these farms did not have sharecroppers. The work was done by the operator and members of the family, by swapping labor with neighbors, and by hiring a small amount of cash labor in rush periods.

Farms with sharecroppers produced nearly four times as many acres of cotton as were produced by farms without sharecroppers. (See table 40.) The cost to produce one acre of cotton was greater where sharecroppers were used, but this was due principally to the high cost of labor which was paid with one-half of the cotton crop and to less efficient use of this labor on the larger farms. 1944 was a very favorable year for producing cotton in Northeast Mississippi, and the half of the cotton crop going to the tenant as payment for his labor explains to a large extent the difference in cost per acre. Labor on farms without croppers was valued at the current rate paid labor without lodging and meals.

Table 40. Farms with sharecroppers and farms without sharecroppers related to various factors, Northeast Mississippi, 1944

Factors	Eight farms with sharecroppers	Eight farms without sharecroppers
Acres of cotton per farm	31	8
Lint cotton per acre, lbs.	569	459
Cost per acre, dollars	94	64
Cost per pound of lint, cents	13.06	10.67
Profit per acre, dollars	50	51
Man hours per acre of cotton, hours	162	131
Man hours cost per pound, lint, cents	8.34	5.66
Labor return per hour on cotton, cents	71	67
Soil fertility	High to medium	Medium
Crop adaptation	Good	Good to fair
Labor income* dollars	$2,021	$1,019

*It should be kept in mind that all of these farms produced milk for the market.

Labor returns per hour spent on cotton for sharecropper farms were slightly above the labor returns on farms where there were no sharecroppers. The larger yield on farms with sharecroppers contributed to this difference. Farms with sharecroppers had soils with higher fertility and better soil-crop adaptation, all of which was a contributing factor affecting labor returns.

Summary

This study was based on farm records kept by 40 farmers in 5 counties of Northeast Mississippi for the year 1944. Farms were selected in the Black Prairie, Northeast Highland, and Pontotoc Ridge soil areas, and were further selected on the basis of emphasis placed on milk cows and cotton.

The average acreage per farm was 170 with cropland amounting to 44 percent. Open, tillable pasture amounted to 25 percent of all land, and open non-tillable land represented 12 percent.

Milk cows were the most numerous livestock on the average farm with 14 head each. The range in number was from 4 to 40.

The average investment per farm was $10,743. Total real estate investment amounted to $38 per acre and livestock, equipment, feeds, and miscellaneous supplies amounted to $25.20, which gave a total farm investment of $63.20 per acre. Average farm receipts amounted to $5,930; farm expenses were $3,973, and the average labor income was $1,420 per farm.

Milk was produced for sale on all farms. There was an average of 14 milk cows per farm with an annual production each of 3,931 pounds. The feed cost was 59.6 percent of the total cost of producing 100 pounds of milk. Man labor amounted to 27.3 percent. The net farm cost to keep a cow for one year was $120.98, and the net farm cost to produce 100 pounds of milk was $3.08. With an average hauling charge of 25 cents per 100 pounds, the cost of 100 pounds delivered at the plant was $3.33.

The cost of producing milk delivered at the plant on dairy-cotton, cotton-dairy, and dairy & cotton farms was $3.27, $4.09, and $2.83, respectively. Similarly the profit per cow was $36, —$7, and $42. The average cost to keep a cow for 1 year on dairy-cotton farms was $120; on cotton-dairy farms, $130; and $113 on dairy & cotton farms. (Price received at plant.) It will be noticed that costs were least and labor returns were highest on dairy & cotton farms.

Thirty-two farms produced cotton averaging 21.8 acres and 20.2 bales ginned per farm. The average price received per pound of lint cotton was 21.21 cents, and the cost to produce one pound of lint was 13.28 cents. Man labor constituted 60.5 percent of the total cost to produce 1 pound of lint. An average of 141 hours of man labor was required on the 32 farms to grow 1 acre of cotton. On dairy-cotton farms, 112 hours of man labor were required to produce 1 acre of cotton. On cotton-dairy farms, 151 hours were required, and dairy & cotton farms required 120 hours. The cost to produce a pound of lint cotton on dairy-cotton, cotton-dairy, and dairy & cotton farms was 13.31 cents, 13.55 cents, and 12.42 cents, respectively.

The cost to produce a bushel of corn was 95.5 cents; 100 pounds of live pork, $12.41; and the cost to keep one head of workstock for a year was $105.82.

Cotton-dairy farms had more total acres, cotton acres, crop acres, and a larger investment than the dairy-cotton or dairy & cotton farms. Farms in the Black Prairie soil area ranked highest in all measures of size of farm business. The Northeast Highland came second and the Pontotoc Ridge Area was third.

As the man work units per farm increased, the number of cows increased, acres of cotton increased, and labor income increased. Labor returns per hour of labor increased as the number of cows in the herd increased. In general, as the acres in cotton per farm increased, the man hours of labor required to produce one bale increased. This seems to be due to the fact that as the size of the farm increased, the number of sharecroppers per farm increased, which indicates that sharecropper labor was used less efficiently. Also, as the man equivalent available for work on the farms increased, the units worked per man decreased. With man labor constituting 60.5 percent of the cost of producing a pound of lint cotton, the efficient use of labor is of vital importance. Labor requirements per cow were lowest on dairy & cotton farms.

Cotton-dairy farms kept the lowest producing cows and dairy & cotton farms kept the highest producers. There was little relationship between the amount of milk produced per cow and the size of the herd. Cows producing less than 3,000 pounds of milk per year showed a loss of $15.75 per head, whereas cows producing above 5,000 pounds netted the farmers $44 each. The average annual production per cow for the 40 farms was 3,931 pounds, and production per cow on dairy & cotton farms was 4,392; on dairy-cotton farms, 3,993 pounds; and on cotton-dairy farms, 3,413 pounds. Farmers keeping cows that produced above 5,000 pounds produced the last 3,000 pounds of milk at a cost of $1.70 per hundred when compared with production per cow of less than 3,000 pounds. Labor returns per hour spent on milk cows increased as the milk produced per cow increased, and the annual labor return per cow was $85 where production averaged above 5,000 pounds.

The production of lint cotton per acre ranged from 196 pounds to 837 pounds. Seventy-five percent of the farms producing cotton had an average yield of about 400 pounds per acre, and 44 percent had a production above 500 pounds per acre. All types of farming showed an increase in man hours required per acre, total costs per acre, and profit per acre as the pounds of cotton produced per acre increased. The yield was slightly more than a bale per acre on both cotton-dairy and dairy & cotton, and only 2/3 bale per acre on dairy-cotton farms.

The principal combination of farm enterprises on farms was cotton, milk cows, corn and hay. Cotton and milk cows were the major income enterprises. Farms placing major emphasis on cotton lost $7 per milk cow, but made a profit of $38 per acre on cotton. Farms placing about the same emphasis on both cotton and milk cows received the greatest return per cow and per acre of cotton. Farms producing milk at the highest cost produced twice the acreage of cotton that was produced on low cost farms. Variations in the proportionate combinations of enterprises on farms producing cotton and milk at a high cost and a low cost (table 33) was not significant, except for the difference in cotton acreage, which would indicate that differences in costs were due more to such factors as capacity of cows, feeding practices, pasture per cow, quality of seed, amount of fertilizer used, soil fertility, labor efficiency and the managerial ability of the farmer.

The cost to produce one pound of cotton increased as soil fertility decreased. The cost relationship was the same for each of the soil areas.

The rate of crop production was highest where soil-crop adaptation was good. The cost of producing cotton per pound was 23 percent greater on farms with poor soil-crop adaptation than on farms where soil-crop adaptation was good. It cost 50 percent more to produce corn on farms where the soil-crop adaptation was poor than where it was good; and labor income was highest on farms where soil-crop adaptation was good, and lowest on farms with poor soil-crop adaptation.

Sixty-four percent of the milk produced by 571 cows on 40 farms was produced from April to September, inclusive, or in one-half of the year. The daily average amount of milk sold per cow in the months of January, February, and March was 7.3 pounds, or less than 1 gallon. Milk production per month for the 571 cows increased 117 percent from January to May, and decreased 50 percent from July to November. Cows producing below 3,000 pounds of market milk per year, and dropping very low in winter production, produced milk at a cost of $3.88 per 100 pounds with a labor return of 25 cents per hour. Cows producing from 4,000 to 5,000 pounds of market milk annually produced at a cost of $3.41 per 100 pounds and gave a labor return of $0.58 per hour.

On five farms where milk production was lowest per cow in January, the average amount produced daily by each cow was 4 pounds—less than ½ gallon. These same cows reached their peak production of 14 pounds of milk per day or 1.6 gallons in May. On five farms where winter production was relatively high, the average daily production per cow in January was 13 pounds. Low winter producers were kept at a loss of 15 cents per day in January, and relatively high winter producing cows were kept at a gain of 10.4 cents per day. Profit per cow was three times as great and labor returns per hour were twice as great, on farms where winter production per cow was relatively high.

The cost to produce one acre of cotton was greater where sharecroppers were used, but this was due principally to the high cost of labor which was paid with one-half of the cotton crop and to less efficient use of this labor available on the larger farms.

Recommendations

In summary, the findings of this study appear to suggest the following recommendations:

Keep high producing cows. Cows with a production below 3,000 pounds gave an annual labor return of $14. On farms where production was above 5,000 pounds, the return was $85 per cow.

Grow cotton on soils of high fertility. The cost to produce cotton on farms of high soil fertility was 12.58 cents per pound, whereas the cost was 14.67 cents on farms of low soil fertility, or a cost spread of nearly 2 cents. This spread of cost between high and low fertility farms was nearly 4 cents per pound in the Black Prairie area. On land that produced between 700 and 800 pounds of lint per acre, the profit on each acre was $83. On land that produced between 200 and 300 pounds of lint, the profit per acre was only $15.

Use labor more efficiently. Cows on which 125 hours were spent gave a labor return of $0.56 per hour, and cows on which more than 200 hours were spent gave a labor return of only $0.18 per hour.

The average cost to grow a pound of lint was 13.28 cents. Labor amounted to 8.04 cents of this cost, or 60.5 percent of the total cost to produce a pound of lint cotton. On farms where the average labor performed per man available was less than 100 days during the year, the man labor cost to produce 1 pound of lint cotton was 9.3 cents. Where the days of labor per man were 250 and above, the man labor cost was 5.2 cents per pound.

Place major emphasis on both cotton and dairy enterprises. There is a definite place for both cotton and milk cows in the organization of farms in Northeast Mississippi. This combination of enterprises permits more efficient use of labor and farm by-products, and cotton and dairy cows supplement each other by giving the farmer a higher return per hour for his labor.

Labor return per hour spent on milk cows on dairy & cotton farms was $0.61. On dairy-cotton farms the returns were $0.47 per hour and on cotton-dairy farms it was only $0.22 per hour. On dairy & cotton farms labor returns per hour spent on cotton was $0.81, whereas it was $0.49 and $0.61, respectively, on dairy-cotton and cotton-dairy farms.

Grow crops on soils to which they are best adapted. On farms where soil-crop adaptation was good, the cost to produce a pound of cotton was 12.42 cents, and the cost to produce a bushel of corn was $0.94. Where soil-crop adaptation was poor, the cost was 15.17 cents per pound for cotton and $1.41 per bushel of corn.

Feed cows for winter production. Low winter producers gave a labor return of $0.35 per hour. Relatively high winter producers returned $0.72 per hour.

Breed for winter production. Cows bred to calve in the late fall are available for their best flow of milk in the winter months as well as in the spring and early summer months.

Reduce costs by increasing rates of production. Farms that produced cotton at the lowest cost had the highest yields, or 1.14 five-hundred pound bales per acre, and farms producing cotton at the highest cost had the lowest yields or 0.78 five-hundred pound bale per acre.

Cows producing less than 3,000 pounds of milk annually, produced it at a cost of $4.51 per 100 pounds, and cows producing more than 5,000 pounds produced it at a cost of $3.11 per 100 pounds, or a difference of $1.40.

Large farms should use available labor more fully. Days of work (10-hour days) per man on farms with more than three man equivalents available averaged less than 125 for the year. Days of work per man on farms with 1.6 man equivalents available averaged 310.

Keep only workstock needed. The net cost to keep one head of workstock for a year was $106.

Use workstock more efficiently. The average head of workstock was used only 46 ten-hour days during the year.

BULLETIN 432 JUNE, 1946

FARM FORESTRY
IN
MISSISSIPPI

Compiled by D. W. Skelton, Coordinator Research Information jointly representing Mississippi State Vocational Board and : Mississippi Agricultural Experiment Station

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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INTRODUCTION

Forests are one of Mississippi's most important natural resources. About 54 percent of the land in the State or 16-1/2 million acres are devoted to forests. About 14 percent of the annual income in Mississippi is derived from forest products. Forests and related activities also contribute approximately 13.3 percent of the tax paid into the State Treasury. It is estimated that the average annual income from farm woodlands alone amounted to $16,890,000 during the period from 1941 to 1944. However, there are a great many farm forestry problems and thus a dire need for better woodland management throughout Mississippi.

There are many evidences of existing problems and the need for better forestry practices. One of these is the fact that about 3.700,000 acres of forest land have burned, on the average, each year for the past 5 years. Another obvious condition is that only a very small percentage of farmers thin their forests or make improvement or liberation cuttings, nor do they harvest only the timber that is ready to harvest. In too many cases no cutting is done for several years and then everything is cut. In other words, clear cutting is too generally practiced. Other unsatisfactory practices could be mentioned but the fact that the average annual growth per acre is only about 100 board feet is evidence enough that better practices are needed. Forestry specialists estimate that the average production per acre per year of Mississippi's forests should be 300 board feet or better with the use of good forestry practices.

Through chemical and other research, many new wood products and uses of forest products are being found each year. Many of these products are necessary and some are indispensible in everyday life. Thus, forests are becoming, from day to day, increasingly important.

With the realization, by agricultural leaders and farmers, of these facts, viz., that forests provide a good part of the farm income, that forest products are becoming more important, and that farm woodlands could be made to provide a much greater income, there has been an increasing demand for information on this subject. The amount of experimental information on farm forestry is somewhat limited, especially in Mississippi, when compared to some other agricultural products. However, an attempt is made in this bulletin to bring together results of many experiments and other information available that seem applicable to Mississippi conditions and condense it as much as possible and yet cover the subject of forestry so far as it relates to farm woodlands and practices.

It is hoped that this information will be helpful to agricultural leaders in directing and teaching farmers and farm boys to use better forestry practices, thereby increasing their farm income.

Reference: Report of Mississippi State Forest Service in cooperation with United States Forest Service, "What the Forest and Forest Industries Mean to Mississippi," Jackson, Mississippi, 1945.

PART I

FOREST ECONOMY OF MISSISSIPPI

This first section is written with the view of giving the technical agriculture workers in Mississippi a clearer insight of the importance of forestry in the State. The discussion on economic importance was taken largely from an article by the Mississippi Forest and Chemurgic Association.

ECONOMIC IMPORTANCE

Mississippi's first principal industry was that of manufacturing forest products. As a foundation of industry and as a source of employment of our people, timber has continued to hold this foremost place to this day. In 1944, the sale value of finished forest products in Mississippi was $137,025,852, as revealed by the State Tax Commission. During this period some 60,000 Mississippians were employed as industrial workers and many more thousands as woods and maintenance crews.

TIMBER A MAJOR SOURCE OF INCOME TO THE RAILROADS

Most of the railroads in Mississippi were built primarily for the moving of timber products, many are still dependent to a great extent on timber movements and some could not exist were it not for the revenues they receive from this source.

The Interstate Commerce Commission records show that the class-one railroads operating in Mississippi originated in carload lots 11,149,230 tons of revenue forest products in the years of 1943 and 1944. This tonnage amounted to 45 percent of the total tonnage originated by these roads during this 24-month period.

According to records of the Mississippi Public Service Commission, all railroads operating in Mississippi in 1944 originated in carload lots 6,079,050 tons of revenue forest products, which amounts to 47 percent of all carlot tonnage originating in the State in 1944.

TIMBER CONTRIBUTES TO SUPPORT OF MANY OTHER BUSINESS ENTERPRISES

Truck, automobile and gas businesses supported by timber operations contribute millions of dollars to our State, County, and City Governments and furnish employment to many thousands of our citizens. Some operators and tax authorities state that the taxing units of the State receive more revenue from the automotive business engaged in timber operations than that received from the railroads' timber business.

The State-wide distribution of forest income makes the most useful, versatile and stabilizing factors of the many manufacturing pursuits of the State.

TIMBER AS A TAXPAYER

How timber taxes affect the State Treasury. As revealed by the Manufacturers' Tax Division of the State Tax Commission the sales value of finished forest products manufactured in Mississippi from

June 1, 1943, to December 31, 1944, a period of 19 months, was $216,957,608 or an average of $11,418,822 each month. This new money coming direct from the State's forests is worth millions to the State annually in the form of manufacturing and income taxes.

During the past 4½ years, Mississippi has produced approximately 2,400,000,000 feet of forest products annually and information collected indicated that each thousand feet manufactured incurred a labor and handling cost of $40, which presents an annual payroll of some $96,000,000.

From a sales tax standpoint, if this payroll were spent one time it would net the State $1,920,000. If it were spent four times, which seems to be the approximate turnover, it would net the State $7,680,000 in sales tax alone. To be safe in the calculation, it might be said that if half of the transaction of money spent is on items which carry no sales tax, there would still be an annual sales tax revenue to the State of $3,840,000.

Timber operation taxes collected in 1944 by State Tax Commission

Sales tax on labor earnings, turnover	$3,840,000
Manufacturers tax of 1/4 of 1 percent	342,564
Severance tax	250,242
Income tax on forests products **Manufacturers**	2,155,239
Total	$6,588,045

Other taxes collected on timber operations of which definite amounts are unknown but considered to equal or surpass those cited above, are:

JOBBERS AND WHOLESALERS TAX 1/8 OF 1 PERCENT.

RETAIL SALES TAX ON FOREST PRODUCTS 2 PERCENT.

INDIVIDUAL INCOME TAX EARNED FROM TIMBER OPERATIONS.

TAXES COLLECTED FROM RAILROADS IN PROPORTION FOR TONNAGE OF FOREST PRODUCTS MOVED.

PRIVILEGE TAX ON WOOD USING PLANTS.

ADVALOREM TAX ON PLANTS AND INVENTORY STOCKS.

TAX ON TRUCKS, CARS AND MOTOR EQUIPMENT IN TIMBER OPERATIONS.

The farm woodlands play an all important part in the over-all forest economy of Mississippi as is shown in the following paragraph:

According to the 1940 census about 54 percent of the total land, or 16,500,000 acres, was devoted to forest. The same census shows that of this acreage, farmers owned 6,068,000 acres. A more recent survey of forest ownership in the South, including Mississippi, shows farm ownership to be approximately 10,000,000 acres.

The Severance Tax Division of the State Tax Commission estimates that 80 percent of the total State production of forest products during the period 1941-1945 came from farm woodlands. On this basis, and using the 2,400,000,000 board feet annual cut production figures for Mississippi for that period, the farmers produced

1,920,000,000 board feet of forest products each year from 1941 to 1944.

If it had been possible for all the farmers to deliver these forest products to the rail head, the average price received would have been about $20 per thousand in the log or a total of $38,400,000 annually. It is estimated that 80 percent of the farmers sold their timber on the stump at an average price of $6 per thousand or a total of $9,210,000. The remaining 20 percent delivered their products to the market and at an estimated price of $20 per thousand, or a total of about $7,680,000. Adding these two figures together the farmers of Mississippi have received approximately $16,890,000 annually from 1941 to 1945 for forest products. Whereas, as already stated, they might have received over $38,000,000 if all of them could have delivered their products to the market. It should be pointed out that the 20 percent who delivered their products to market received more than 80 percent as much for their products as the remaining 80 percent of the farmers received for theirs on the stump. Of course, it may not be possible for all farmers to deliver their forest products to the market but the difference in the prices is certainly an incentive for them to make every effort possible to do this.

EMPLOYMENT

The forests provide, directly and indirectly, employment for a large percentage of the people in Mississippi who are employed, especially in the industrial groups. According to the 1945 report of the State Forest Service in cooperation with the U. S. Forest Service, 55,000 people are employed in the woods and plants manufacturing forest products. The report further shows that 11 people are employed in the woods and forest industry for each 5 people employed by transportation, 5 in construction, and 15 in all other manufacturing. In other words, for each 11 people employed in woods and forest industry there are 25 employed in transportation, construction, and all other manufacturing.

According to the Southern Forest Experiment Station, approximately 61 acres of forest land will provide full-time employment for one person. This includes forest management, fire protection, cutting, loading, and hauling, as well as milling of all products. On this basis, Mississippi's 16,500,000 acres of forest land would provide full-time employment for over 254,000 men. Mississippi has, according to 1940 U. S. Census, 291,092 farm operators (all nationalities). Assuming that these operators could spare only one-fourth of their time for forest work, this number would be equivalent to 72,773 full-time workers in the forests. Thus, it can be seen that a very large number of additional workers could be employed in Mississippi in the forests alone. In order to put all of the Mississippi forests under proper management and supervision, it would require a detailed and thorough educational program which would necessitate the employment of a large number of technical workers in the educational field, such as farm forester's supervisors, educational instructors in public schools, etc.

The forest is certainly one of Mississippi's most important natural resources. Up to the present time the subject of forestry has been sadly neglected in our educational program in Mississippi. It is imperative that steps be taken to conserve this resource to the maximum and at the same time increase the annual income from forests through better forestry practices.

References: (1) 1945 Annual Report of State Forest Service, Jackson, Mississippi. (2) Agricultural Census, first series, Mississippi, U. S. Department of Agriculture, Washington, D. C., 1940. (3) Leaflet by Mississippi Forest and Chemurgic Association, Jackson, Mississippi, January, 1946.

PART II

KINDS OF TREES IN MISSISSIPPI

CONIFERS (Needle-like)

The various pines and other conifers are very important in Mississippi. Some species of pine are found growing in every county in the hill section of the State. Cypress is found in the delta section with bottomland hardwoods.

These trees are listed below according to their importance, along with the principal uses of each tree.

Best Species Group

KIND	COMMON USES
Longleaf pine	Construction, piling, poles, naval stores, pulpwood and ties.
Slash pine	Same as longleaf.
Shortleaf	Construction, poles, piling, pulpwood and ties.
Loblolly	Same as shortleaf.
Cypress	Construction, shingles, boats and other uses where durability is important.
Red Cedar	Cabinet work, fence posts and poles.

Poorest Species Group

KIND	COMMON USES
Spruce pine (Other common names, turkey, black and cedar pine)	Pulpwood and lumber to some extent.

HARDWOODS

Space will not permit a detailed description of all the hardwoods in Mississippi. Therefore, the more common and important species from the standpoint of use only are listed below and opposite each specie is shown some of the most common and important uses of these trees.

These species are listed in groups according to quality or importance mainly as they occur in the delta section of Mississippi but they would be grouped similarly for the hill section.

Best Species Group

KIND	COMMON USES
Bottomland red oak	Lumber and ties.
Willow oak	Lumber and tight cooperage.
Water oak	Lumber.
Cherry bark oak	Lumber, ties.
Cow oak (Swamp chestnut oak)	Lumber, tight cooperage and railroad and heavy structural material.
Water oak	Cooperage and lumber.
Post oak	Lumber and posts.
White ash	Lumber, specialties such as vehicle stock and athletic goods, also slack cooperage.
Green ash	Same as white ash.
Sweetgum	Lumber for interior furnishings, cabinet work, furniture, auto bodies, etc.
Persimmon	Shuttle blocks, golf club heads and novelties.
Dogwood	Shuttle and novelty stock.
Mulberry	Fence posts.
Black walnut	Lumber for interior furnishings, cabinet work, etc.

Intermediate Species Group

KIND	COMMON USES
Overcup oak	Lumber
White elm	Slack cooperage, crating, barrel hoops and lumber
Rock elm	Lumber
Winged elm	Same as white elm.
Hackberry	Slack cooperage, principally, also cheap furniture and crating.
Willow	Lumber for boxes, crating, and pulpwood.
Red maple	Lumber and slack cooperage.
Sweet pecan	Used for furniture and baseball bats.
Bitter pecan	About same as for sweet gum.
Hickories	Thick lumber and dimension stock, vehicle spoke and handle stock.
Honey locust	Lumber for cheap furniture, auto bodies, ties and posts.
Sycamore	Lumber for interior furnishings, furniture, boxes and crate stock, and slack cooperage.
Black gum	Lumber for furniture stock and ties.
Swamp cottonwood	Lumber for wagon boxes, crating and furniture.
Cottonwood (Southern)	Same as swamp cottonwood above.

Poorest Species Group

KIND	COMMON USES
Boxelder	Used for slack cooperage, boxes, and crate stock.
Planer tree	Same as for elm.

Detailed descriptions of all the most common forest trees of Mississippi may be found in Extension Bulletin No. 32, "Forest Trees of Mississippi." This bulletin may be secured from the Mississippi Extension Service, State College, Mississippi.

References: (1) Occasional Paper No. 27, "The Trees of the Bottomlands of the Mississippi River Delta Region," pp. 16 to 29, Southern Forest Experiment Station, New Orleans, Louisiana. (2) Leaflet, "Improvement Cuttings in the Bottomland Hardwood Forests in Mississippi," Southern Forest Experiment Station, New Orleans, Louisiana. Reprint from "Southern Lumberman." December, 1940.

PART III

SOME PRINCIPLES OF FARM WOODLAND MANAGEMENT

A few years ago farm woodlands were considered as so much poor pasture or waste land. More recently they have been used as a source of income for the payment of taxes on the farm, and many farmers are using them as a reliable "cash crop" in addition. Except in unusual cases farm woodlands will, undoubtedly, never provide the major source of farm income in the Delta and Prairie Counties, but in other parts of the State some are already providing the major source of farm income and with proper timber management this may be brought about in many of the counties of the State. The proper increase in the yearly production income may provide a very real source of off-season employment as well.

With so many farmers really interested in the proper handling of their woodlands, it will be desirable to review the more important principles of good timber management and to assist farmers whenever possible to set up a desirable plan of management. Although the woodland has great financial possibilities, farmers should at the same time realize that it is impossible to change a badly mismanaged and practically worthless timber stand into a highly productive one overnight, just as it is impossible to change a worn out and badly eroded field into a highly productive one in a few months. The principal topics discussed below on this subject of farm woodland management are: (1) Improvement cuttings, which includes (a) liberation cuttings, (b) thinning, and (c) pruning; (2) harvest cutting, which includes discussions on (a) selective cutting (individual tree and group selection), (b) seed tree method and (c) clear cutting method with natural and artificial reproduction.

IMPROVEMENT CUTTINGS

An "improvement cutting," as the name implies, is the cutting of timber in a forest or woodland for the purpose of improving the condition and composition of the stand. When it involves the freeing of young, desirable growth from competition with "wolf" trees or cull trees, it is called a liberation cutting, and when it is made in immature stands for the purpose of increasing the growth of the trees that are left, it is called thinning.

LIBERATION CUTTINGS

Practically all woodlands contain from a few to a large number of low quality or practically worthless trees, usually called "wolf" trees or cull trees, as a result of past cutting practices whereby each time a stand is cut over, the better trees are usually removed and no effort is made to get rid of the ones that have little value. Before any serious attempt is made to manage such a stand, these low quality and worthless trees should be removed if they have any value, or girdled if valueless. Very crooked, very limby, rotten, and other cull trees may reduce the effective growing area of a woodland by one-half or more, and attempting to grow a crop of timber on such areas is very similar to an attempt to grow a good crop of corn in an uncultivated field; the yield in both cases will be inversely proportional to the number of

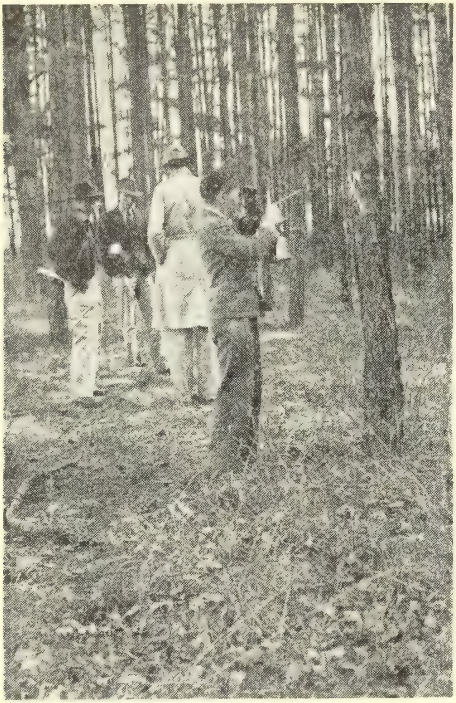

FIGURE 1—W. M. Shuffield, Jr., marking timber to be cut at a timber stand improvement demonstration on the property belonging to his father, 4 miles east of Maben, Mississippi.

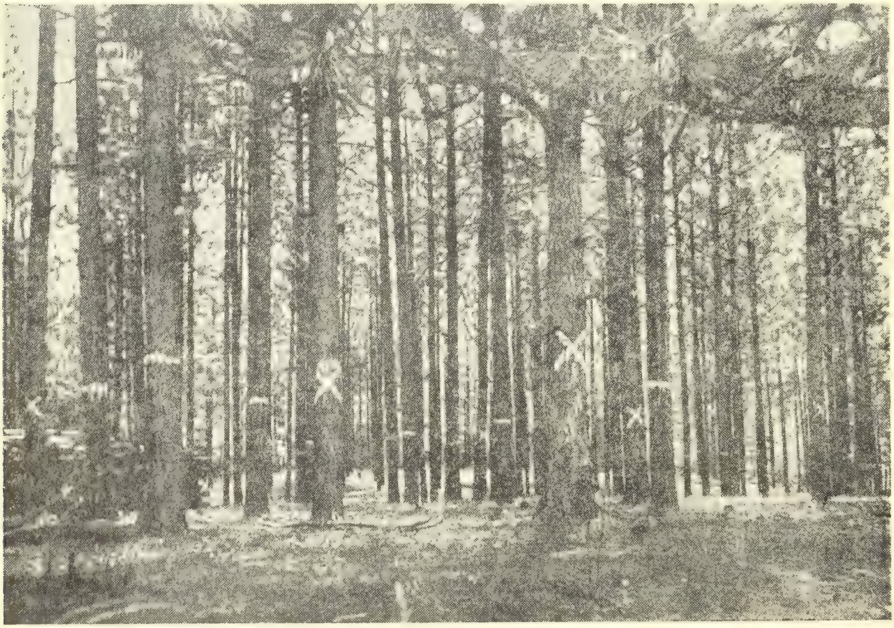

FIGURE 2—Trees marked with X are to be harvested in this improvement thinning cutting and sold as sawlogs. Trees with band were left to produce better grades of sawlogs, poles and piling for future sales. Tops left after loggings were used for pulpwood and fuel wood.

weeds present. Girdling of these trees by cutting the through bark and cambium layer (if unmerchantable), of course, costs money or effort. However, studies made by the Southern Forest Experiment Station have indicated that increased growth on the reserved trees as a result of girdling the worthless trees, will usually more than pay for the operation within a 5-year period. Even in mature stands that are to be cut selectively, the first cutting which takes out the low quality and worthless trees may be considered an improvement cutting, even though 40 percent of the total volume of the stand is removed.

As pointed out in Part VII of this bulletin in the Fuel Wood Section, this type timber may be used for fuel wood and the cuttings made as the need arises for such products. More time may be required to make improvement cuttings in this way, but certainly it would be a dual purpose cutting in that at the same time improvement cuttings are made, farm needs are being fulfilled and a waste of timber is also prevented.

The maximum possible growth and profit from the management of timberlands are not possible except through improvement cuttings of the proper intensity made at the proper times in the life of the stand.

In some cases a part of such cuttings may be used for crossties, or sawlogs if the timber is of sufficient quality. If the owner is not equipped to make his own improvement cuttings, he can mark the trees to be cut and sell by contract to the highest bidder even though the trees might be small.

THINNING

In order to grow tall, straight trees, it is necessary that they be grown close together. Otherwise, they will develop heavy side limbs and short boles or trunks. Competition for light forces height growth, and prevents the over-development of side limbs. As height increases, the lower limbs die, and fall off or break off from the effect of the wind or other mechanical forces. This results in earlier growing of knot-free lumber.

Crowding, in time, works to the harm of the trees in that root competition for water and minerals and crown competition for light, as the tree increases in size, reduces the percentage of tree in live crown, thereby lowering the food manufacturing part of the tree. This causes the tree to slow down in growth in proportion to crown reduction, the crown being the upper part of a tree including the branches with their foliage. The trees thus reach a point where natural mortality off-sets the increase in volume per acre. This point is known as stand stagnation and is the time for a thinning, which by reducing competition and affording more growing space, will increase the growth of the remaining trees. This, in part, is brought about by increased development of the crowns of crop trees. No other thinning will be needed until the crowns of crop trees once more become crowded and begin to interlace with each other.

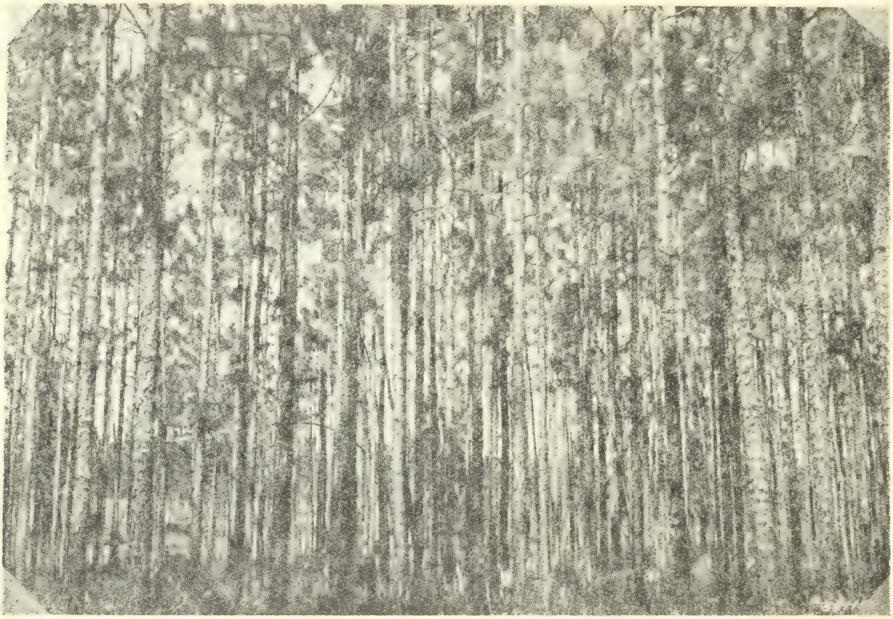

FIGURE 3—A stand of young longleaf pine in need of thinning.

If nature is permitted to take its own course, competition will be so keen that a percentage of the trees will die annually. This is an economic waste because by thinning at the right time, all the trees that will eventually drop out and be wasted can be utilized for fuelwood, pulpwood, small sawlogs, and small poles. The net result being that the final crop will be 60 to 120 trees, 16 to 24 inches in diameter, in both cases. The difference is that by proper thinning the trees can be grown to that size in anywhere from 10 to 30 years sooner than by natural thinning, and a cash return from each thinning made for the owner instead of being wasted otherwise.

A study in thinning is underway at the Crossett Experiment Station, Crossett, Arkansas, with a stand of loblolly pines. At the beginning of the test the trees were 40 years of age and there was an average of 400 trees per acre. The trees had been stagnated for nearly 20 years, showing very little net increase (0.01 cord per acre year, 1939). The small growth on the living trees was practically wiped out, on an acre basis, by the annual loss in trees dying out from overcrowding. To try to find out how many trees should be removed, five 1-acre plots were cut over, each one heavier than the former. One acre of trees (400 per acre) were left unthinned as a check plot. The results of this thinning one year afterwards is shown below:

Table 1. Results of thinning loblolly pines, Crossett, Arkansas

Plot number	Number of trees left per acre	Net growth per acre per year one year after thinning
1	200	0.97 cords
2	100	0.45 cords
3	70	0.38 cords
4	40	0.31 cords
5	Cut to 7" diameter limit with seed trees	0.04 cords
6	Uncut plots—400	0.01 cords

Glancing at the above results it might appear that removing 200 trees per acre and leaving 200 crop trees per acre was by far the best method. This is true for the first year and maybe for the first 2 years; however, several factors enter the picture at this point. After 2 or 3 years the stands with 100, 70, and 40 cash trees per acre left, showed a rapid increase in their net growth per acre over that of 0.45, 0.38, and 0.31 cords per acre per year, as shown above for the first year, while the net increase per acre of the plot with 200 trees increased very little above its first year net of 0.97 cords per acre. By the end of the third year after thinning, the first plot with 200 trees per acre was ready for another thinning because the crowns had grown together again, forming a closed canopy. The stands of 100 trees per acre probably will not have to be thinned for 5 years after the original thinning, while the 70 and 40 trees per acre will probably need no more thinning, reaching financial maturity without becoming too crowded again.

Studying these results it would appear that if a farmer had a similar stand of trees he would have to decide several things before cutting any trees: First, would he like to have an income from his timber at short intervals of say 2 to 4 years and get the maximum production from his land? Second, does he have to have more money at the time of harvest than a light thinning would provide? Third, can he wait 5 to 10 or 15 years until the next timber harvest? If his decision is the first, then he would leave (in a stand of the same conditions as described above) between 150 to 200 trees per acre. If his decision is either of the last two, then he can remove more trees, leaving 40 to 100 trees per acre, depending on how long he wants to wait for the next harvest. It is taken for granted here that 200 trees per acre was the maximum number and 40 the minimum number to be left.

Farm woodland owners should, therefore, plan to start thinning dense stands as soon as the trees become merchantable (at fuelwood or pulpwood size) and should make repeated light thinnings in order to prevent slowing up of the growth rate. At the same time as many trees as will grow satisfactorily should be carried on each acre.

Spacing of trees left. One rule of thumb for spacing of trees is to add four to the number of inches which the diameter of the tree measures at breast height and use this number in feet for the spacing of trees. Example: For a 5-inch tree add 4 to 5 which equals 9; thus 5-inch trees should be spaced about 9 feet apart. Likewise, 7-inch trees should be 11 feet apart. and so on. This will usually give a crown space of an opening between any two trees as wide as the crown itself. The crop trees left will then grow at a more or less constant rate until the crowns of adjoining trees begin to interlock. The stand then is ready for the next harvest cutting. On pines this may mean a harvest cutting every 4 to 8 years.

Careful pulpwood thinning may be made at any time of the year although winter cutting is the safest to protect remaining trees from insect damage.

Reference: Article by R. R. Reynolds. Southern Forest Experiment Station, "Some Principles of Farm Woodland Management," New Orleans, Louisiana, September, 1941.

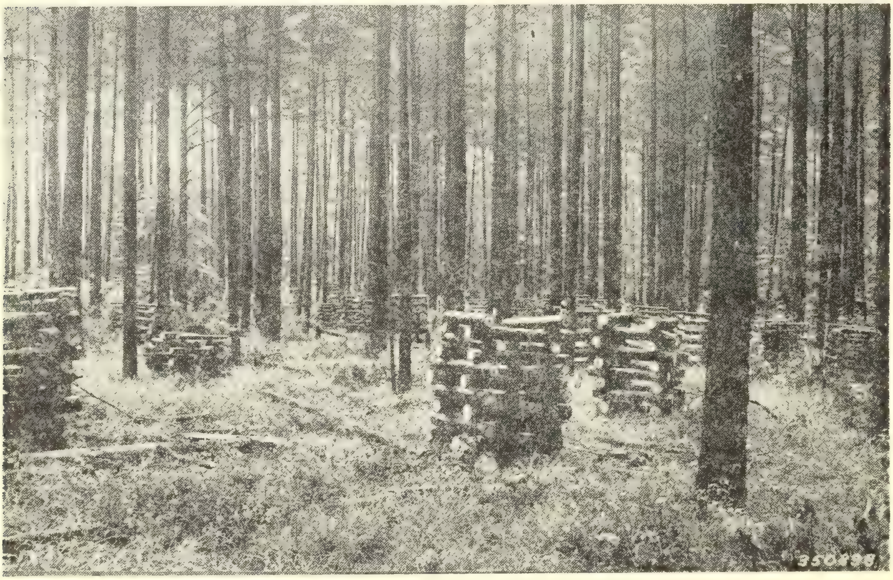

FIGURE 4—Eight cords of pulpwood were harvested ad twenty cords per acre left in this thinning operation. This stand has been cut according to good forestry practices.

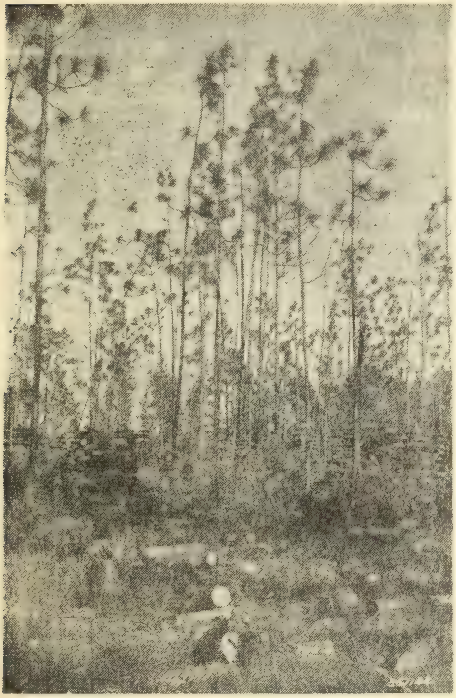

FIGURE 5—This is one of the worst types of overcutting, where all trees 6" in diameter were harvested. Compare this picture with the cutting in Figure 4.

As a further help in arriving at the desirable number of trees per acre, table 2, below, might be helpful.

Table 2. Number of trees per acre 3.6 inches and more in diameter, Louisiana [1]

Age	Trees per acre, by site index			
years	70 [2]	80 [2]	90 [2]	100 [2]
20	810	710	630	560
30	528	437	373	333
40	289	240	205	183
50	219	181	155	138
60	198	164	140	125
70	186	154	131	117
80	176	146	124	111

[1] Forestry Bulletin No. 51, "Yield of Even-aged Stands of Loblolly Pines in Northern Louisiana," by Walter H. Meyer, Yale University, School of Forestry, page 8.

[2] Site index is the average height of a stand of timber at 50 years of age.

The Southern Forest Experiment Station makes the following suggestions concerning thinning technique: [1]

Stands to be thinned should be marked in advance of cutting. When the number of trees to be cut is about the same as, or greater than, the number to be left, mark those to be left. Dry paint or chalk in a bag or sack, whitewash, or liquid paint can be used. Where the trees to be cut are relatively few, mark them rather than those to remain. Be sure an owner does not mark one stand one way and another just the opposite. Experienced cutters, once they are thoroughly accustomed to thinning, can thin without preliminary marking. Special attention should be given to selection of trees to be left. Trees to be cut then are merely those not desirable to leave. They can be thought of as trees to be cut not for the sake of cutting, but rather because they are interferring with the development of the selected trees or because they are not needed in the stand.

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[1] Occasional Paper No. 35, "Thinning Loblolly Pine in Even-Aged Stands," Southern Forest Experiment Station, New Orleans, Louisiana, September, 1934.

Make frequent checks of the number of trees being left, in order to keep the thinning along the lines of the method decided upon. Experience and judgment, however, should have full play and the marking should be governed by these factors rather than by average figures as given here. Local conditions require local treatment.

Mark and thin by relatively small units, such as quarter-acres or small groups of trees, in order to keep the spacing as regular as possible. Thus 200 trees per acre should be thought of as, say, 50 trees per quarter-acre or as trees spaced about 15 feet apart. Spacing should be sacrificed, however, to secure good, sound, straight, and vigorous trees.

PRUNING

Another good forestry practice is the pruning of the lower limbs of trees which are to be reserved for future saw timber. If trees are grown in fully stocked stands, natural pruning will usually result, but in open stands, the side limbs persist indefinitely. Thus, pruning open stands improves the quality of timber and increases the value considerably. This is true because if a tree is pruned when it is very small the knot formed because of the limb, is likewise small and confined to the center of the tree. But if the tree is quite large before it is pruned, either artificially or naturally, large knots are formed which in turn lowers the grade of timber. Pruning open-grown timber also increases the body length of trees. Again the earlier this is done in the life of the tree, the higher the quality of crop trees and the resulting products.

It is not a good practice to use an axe in pruning as serious injury may result from wounds made in the living parts of the tree. A saw should be used instead.

Doubtless the best time for forest pruning of pines in Mississippi is during the fall and winter. Incidentally, the limbs taken in pruning could be used to very good advantage as brush for checking erosion in gullies or as mulch on eroding land surfaces.

Trees under 20 feet in height, prune up to 50 percent of total height. Trees 20 feet in height and over may safely be pruned up to two-thirds of total height of the tree. Pruning should be carried on with a view of producing at least one and sometimes two 16-foot logs.

The selection of the trees to be pruned is of the highest importance, requiring good judgment and careful consideration. The one who selects the trees to be pruned must size up both the merits and defects of the trees, their vigor of growth and promise, their distribution or distance from other trees of the same class; in other words, he must select his crop trees and visualize the stand as it is expected to appear 5, 10, 15 or more years later, depending upon its present age, rate of growth, and the kinds of products to be grown.

Prune only the crop trees, that is, those that will produce poles, piling (although here large knots are not so much of a defect as in poles), veneer logs, and clear sawlogs. It is rarely practicable to prune trees that promise the production only of crossties, pulpwood, fuel wood, or other rough-timber products. There will usually be from 50 to 200 trees per acre ranging in diameter from 3 inches to 8 inches that are considered crop trees and only those trees should be pruned.

Experimental work has shown that the labor cost of pruning open-grown limby pines amounted to approximately 2 cents each for 4-inch trees, 3 cents for 6-inch trees and 4 cents for 8-inch trees. These costs were more than off-set by the increased quality and value of the products sold from the same trees when mature.

References: (1) United States Department of Agriculture Bulletin 1892, "Pruning Southern Pines," pp. 6,7,17,22,23,24,25, and 32, Washington, D. C., January, 1942. (2) Paper, "Some Principles of Farm Woodland Management" by R. R. Reynolds, Forest Economist, Southern Forest Experiment Station, New Orleans, Louisiana, September, 1941.

HARVEST CUTTING METHODS

There are many cutting methods described by various authorities. Only a few of these are discussed below but it is thought that under Mississippi conditions it is not necessary to discuss all the methods. Those described below are (1) selective cuttings by (a) individual tree selection, and (b) group selection; (2) seed tree; and (3) clear cutting. In connection with clear cutting, natural reproduction and artificial planting are discussed.

Since these methods are discussed separately one might get the idea that a farmer could select any one of them and follow it in making his harvest cuttings. However, that is not the procedure intended or suggested. On the other hand, a farmer should take the situation he has and apply these cutting methods according to the conditions that exist on his farm, using the method or methods needed. He may have even-aged or uneven-aged timber stands or possibly both on the same farm. If he has both conditions, he will need to employ a combination of cutting methods. Also, a farmer may have even-aged stands altogether and want to convert them to uneven-aged stands in order to have harvest cuttings and cash returns more often and at the same time possibly get a faster average growth. Too, in any harvest cutting of mature timber, plenty of seed trees should be left.

Some parts of the farm woodland may need improvement cuttings which might be made along with the harvest cutting. Therefore, it is not likely that there are many cases where a farmer would use the principles involved in only one cutting method. But he should use the combination that will give the best growth, returns, and natural reproduction with the particular conditions at hand.

SELECTIVE CUTTING METHOD

Individual tree selection. As the name implies, individual tree selection is that of selecting individual trees for harvest throughout the woodland or forest that are mature or that are retarding the growth of better trees that would otherwise make faster growth and better quality sawlogs than those selected for harvest.

The practice of selective harvesting is now widely employed in the large commercial forests, but is equally suitable and valuable on smaller farm woodlands.

The objective of selective harvesting, as with other good forestry practices, is to assist nature in growing a continuous crop of trees so that after each subsequent harvest of trees, the remaining forest or woodland will be self-replenishing.

Selective harvesting, although it includes the principles of improvement cutting, refers in general to the cutting of mature timber. As pointed out previously, the cutting of defective mature timber is sometimes referred to as an improvement cutting. Ordinarily, selective harvesting does not take place until the timber stand is brought into good growing conditions as a result of the necessary improvement cuttings which have been made at periodic intervals in the development of the timber stand. Several thinnings may have to be made

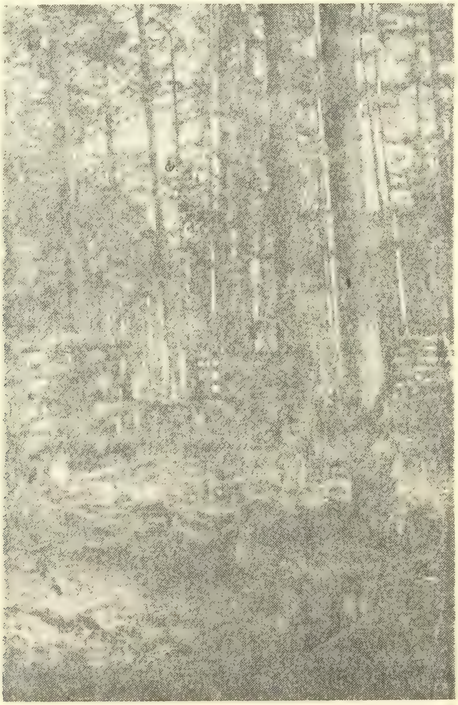


FIGURE 6—Stand of pine after it has been selectively logged over. Sawlogs have been removed, the pulpwood was cut from trees that were either defective, or too small for sawlogs and that needed to be removed. For each thousand feet of sawlogs cut, one cord of pulpwood was cut from the tops.

over a period of 10 or 15 years before the selective cutting operations begin.

A well-stocked, 40-acre tract of the Crossett Experimental Forest, Crossett, Arkansas, is being managed as a farm woodland, from which the growth is removed each year. Only low quality material was removed in earlier cuttings. In 1940, the stumpage value of all products was $2.97 per acre. The average for the 8-year period 1938-45 was $3.99, while the value in 1945 was $4.91 per acre per year. Thus, income from the tract has steadily increased. When the wood was cut and delivered, the returns per acre per year averaged $14.55 for the 8-year period. For 1945 this was $15.09 per acre.

Figures on this 40-acre tract are shown below as to volume of the various products cut, as well as the stumpage value and value delivered to the market for the past 8 years, and for 1945. Also a description of the timber stand is shown before cutting in 1945.

Table 3. Record of 1938-45, inclusive, cut from entire farm forestry compartment, 40 acres, Crossett, Arkansas

Item	Logs	Pulpwood	Fuelwood	Posts	Total
	Board feet Doyle rule	Standard cords	Standard cords	Number	
Volume cut	98,776	249.19	146.57	252	
			Value on stump (dollars)		
Total Cut	**$919.40**	**$266.02**	**$78.85**	**$12.60**	**$1,276.87**
Per unit	[1] 9.31	1.07	0.54	0.05	
Per acre	22.98	6.65	1.97	0.32	31.92
Per acre-year	2.87	0.83	0.25	0.04	3.99
			Value delivered at market (dollars)		
Total Cut	**$1,759.32**	**$1,629.74**	**$1,228.42**	**$37.80**	**$4,655.28**
Per unit	[1] 17.81	6.54	8.38	0.15	
Per acre	43.98	40.74	30.71	0.94	116.37
Per acre-year	5.50	5.09	3.84	0.12	14.55

[1] Logs valued and sold on graded basis.

Reference: Mimeograph "1945 Cutting Record, Farm Forestry Compartment 51—Crosset Experimental Forest," U. S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, New Orleans, Louisiana, October, 1945. Tables 4 and 5 from same source.

Table 4. Description of stand on farm forestry compartment before cutting in 1945

No. of trees per acre			Volume per acre			Growth per acre per year	
4"-12" d.b.h.	12" d.b.h.	Total over 4"	Trees over 4" Cubic feet	Trees over 4" Standard cords	Trees over 12" d.b.h. Board Ft. Doyle Rule	Standard cords trees 4-12" d.b.h.	Sawlogs (bd. ft. Doyle) trees 12 in. up d.b.h.
106	38	144	2.170	26.1 [1]	6,246	0.36 [1]	337

[1] A rough figure for converting cords to board feet is as follows: 1 cord (128 cubic feet) equals 500 board feet. Thus the total growth per acre in table 4 above would be roughly, 500 x 0.36 or 180 board feet plus 337 or a total of 517 board feet.

Table 5. Record of 1945 cut from entire farm forestry compartment (40 acres)

Item	Logs	Pulpwood	Fuelwood	Posts	Total
	Board feet Doyle rule	Standard cords	Standard cords	Number	
Volume cut	13.144	15.33	11.97	42	

Value on stump (dollars)

Total cut	$162.47	$23.00	$8.98	$2.10	$196.55
Per unit	[1] 12.36	1.50	.75	.05	----------
Per acre	4.06	.58	.22	.05	4.91

Value delivered at market (dollars)

Total cut	$300.49	$153.30	$143.64	$6.30	$603.73
Per unit	[2] 22.86	10.00	12.00	.15	----------
Per acre	7.51	3.83	3.59	.16	15.09

[1] Stumpage by log grades, as follows: No. 1 logs, $15.00; No. 2 logs, $12.00; No. 3 logs, $10.00.

[2] Logs sold by grades delivered to mill as follows: No. 1 logs, $25.00; No. 2 logs, $22.50; No. 3 logs, $20.50.

Man-hours of employment cutting and delivering

Item	Logs	Pulpwood	Fuelwood	Posts	Total
Total cut	68.0	155.0	184.0	8.0	415.0
Per unit	5.2	10.1	15.4	0.2	-------
Per acre	1.7	3.9	4.6	0.2	10.4

Returns per hour of labor

1./ Gross return with no stumpage allowance	$1.45
2./ Net return with allowance for taxes, fire protection, 4 percent interest on $1,000 investment and other out-of-pocket expense	$1.13

A special study on 32 farms in Northeast Mississippi last year by Dr. W. J. Edens, State College, Mississippi, shows that labor returns per hour on cotton in 1944 was approximately $0.63. The yield per acre was 0.98 of a bale. The labor returns per acre were $88.92 which is much higher than shown above for timber; however, the wage per hour is higher from timber.

The stand on this 40-acre tract is in better condition than in the beginning and more than one-third of the original volume has been cut and the forest volume is more than the original volume when cutting began in 1938. Another advantage of selective harvesting is that there is no long waiting period for returns. The above tables show that a crop of timber can be harvested annually or the farm tract can be divided into smaller tracts, cutting one of them each year so that all tracts will be cut over every 3 to 5 years which also gives an annual harvest.

There are markets for sawlogs or lumber throughout Mississippi. Hence, the timber grower can plan on producing sawlogs with reasonable assurance of finding a favorable market for his product. Since the tree crop is not perishable, he can postpone his cutting operation for one or more years, if the market is unfavorable. In other words, he can "wait out the depression" without financial loss or without sacrificing his timber, and the trees continue to increase in volume and value while standing there.

Mature trees, or those that have reached the approximate end of their fast growing years, should be marked for cutting, unless they are needed for seed trees. (Always take into account that nature can replant from seed trees much more effectively or efficiently and very much cheaper than can man by artificial means.) But even some smaller trees may be marked for cutting if their removal will speed the growth of better quality trees nearby.

While going about the job of selective harvesting, two purposes are accomplished—increased revenue and an improved woodland.

Ordinarily the selective harvesting of timber should occur at intervals of from 1, 3, 5, 8, and 10 years, depending upon the individual farmer's needs and the need of the individual tracts of timber. A general type farmer with sources of income other than timber, may need to make heavier cuttings or harvests at less frequent intervals, or when he has years of short income from these other sources of income (excluding timber), rather than follow a regular cutting cycle. However, the harvest should never exceed the growth since the last cut. In other words, if a 40-acre tract of farm woodlands averaged 3500 board feet per acre after it has been cut over, and in 5 years has increased to 5,000 board feet and it is decided to make another harvest, do not remove over 1,500 board feet per acre. It would be even better if only 500 board feet per acre were cut, the growing stock would then be built up to 4,500 board feet instead of the 3,500 board feet. After the first harvest cutting, the annual growth might increase to 320 board feet per acre over the next 5 years. This would mean a per year increase of from 4,500 to 6,100 board feet per acre or a net growth of 1,600 board feet. Now if he decided that 5,000 board feet per acre is near a fully stocked stand for his land then he can harvest 1,100 board feet per acre. A fully stocked forest of all sawlog size trees should average, in Mississippi, from 5,000 to 8,000 board feet per acre. Just as with cotton or corn, you have to have a fully stocked stand of trees to get the highest production returns per acre. For example, a stand with only 2,000 board feet per acre may increase at the rate of 150 to 200 board feet per acre, whereas a stand of 6,000 board feet per acre may produce 250 to 300 board feet per acre.

At the Crossett Experimental Forest, Crossett, Arkansas, a cutting plan has been worked out whereby a volume equivalent to the total growth is removed if the stand is fully stocked or contains 1,469 cubic feet or approximately 10,000 board feet per acre. If on a particular woodland, however, the stand contained only 292 cubic feet per acre, or approximately 2,000 board feet, he should remove only half of the growth. And if the stock is somewhere between 2,000 and 10,000 feet, he should remove a proportionate percentage (between 50 and 100 percent of the growth). On this basis the following table which indicates the percentage of the growing stock to be cut if the area is to be cut over every year or every 3, 6, or 9 years has been computed:

Table 6. Percent of growing stock to cut each cycle

Present growing stock		Cutting cycle in years			
		1	3	6	9
M. bd. feet	Cu. feet	Percent			
10	1460	6.0	16	30	41
9	1314	5.5	15	28	38
8	1168	5.1	14	26	35
7	1022	4.7	13	24	33
6	876	4.4	12	22	30
5	730	4.1	11	20	28
4	584	3.7	10	18	25
3	438	3.4	9	16	23
2	292	3.0	8	14	20

Reference: Same as for table 7, page 27.

From the above it can be seen that if the stand is fully stocked and the area is to be cut over every year, 6.0 percent of the total volume can be cut each year and this should be restored by growth during the following year. If the same fully-stocked stand is to be cut over every 3 years, 16 percent of the total volume can be removed and the growth during the following 3 years should build the stand back up to the original volume If the stand contains only 2,000 board feet (292 cubic feet) per acre, 3 percent of the total volume would be cut if the area was cut over every year or 8 percent of the total volume would be cut if the stand was to be cut over every 3 years.

There always has been some woodland owners, who because of the need for ready cash or because of the appeal of a lump-sum payment have cut or allowed all of their timber, with perhaps the exception of a few seed trees, to be cut. In some cases, where it is absolutely necessary to have the money to save the farm, such practice is necessary, but should be avoided wherever possible.

In such cases, however, the owner of the woodland disposes of the possibility of a good steady income in the future for a comparatively small amount of money in a lump-sum payment.

Practically all shortleaf-loblolly pine-hardwood stands, even old-field stands that are of one age, contain trees of many different sizes. Any clear cutting, therefore, removes not only the financially mature trees but also a large number that are not financially mature and that are just at the point of beginning to earn the owner a good return on the investment. Data from recent studies on the value of growth of various sizes when the material is sold for pulpwood may help to bring out this point. Data of interest from this study are as follows:

Table 7. Volumes and pulpwood stumpage values of shortleaf and loblolly pine by tree-sizes on the Crosset Experiment Forest

Diameter at breast height	Volume per tree	Number trees per cord	Pulpwood value per tree at $2.00 per cord stumpage	Value of inch growth in diameter	Increase in value for 1 inch increase in diameter
Inches	Cubic feet		Cents	Cents	Percent
4	0.8	106.2	1.86	0.8	114
5	1.7	50.0	3.99	1.2	80
6	3.1	27.4	7.18	1.9	70
7	5.2	16.3	12.23	2.3	50
8	7.8	10.9	18.35	2.5	36
9	10.7	7.9	25.00	3.0	32
10	14.1	6.0	32.98	3.5	28
11	18.0	4.7	42.29	3.9	25
12	22.4	3.8	52.67	4.1	21
13	27.1	3.1	63.37	4.4	18
14	32.1	2.6	75.27	4.7	17
15	37.4	2.3	87.78	5.1	15

Reference: Article by R. R. Reynolds, Southern Forest Experiment Station, "Some Principles of Farm Woodland Management," New Orleans, Louisiana, September, 1941.

These data show that 4-inch pine trees increase 114 percent in volume and value for 1-inch increases in diameter by the time they become 5-inch trees. Likewise 5-inch trees increase 80 percent in value for 1-inch increases in diameter, 6-inch trees increase 70 percent, 8-inch trees increase 36 percent, and 10-inch trees increase 28 percent. Since it takes, on the average, about 3 years for a well spaced pine tree to increase 1 inch in diameter, 4-inch trees of this class are increasing about 38 percent per year, 6-inch trees about 23 percent per year, 8-inch trees about 12 percent per year, and 10-inch trees about 9 percent per year. Even in normal times when other good investments will yield 4 or 5 percent per year the increase in value of small timber as a result of growth is more than worthy of consideration.

Farmers who sell all trees 4 to 12 inches in diameter for either pulpwood or sawlogs are losing money at a rapid rate. It is equivalent to selling off all the hens in a flock of chickens that are laying from 200 to 300 eggs per year.

A study in which logs were the end product of the management gave similar results. Twelve-inch trees increased in volume and value at the rate of about 30 percent per year, 13-inch trees increased at the rate of about 25 percent per year, 15-inch trees at the rate of about 21 percent per year, and 17-inch trees at the rate of about 14 percent per year. This, too, is a pretty good return on the investment; however, the same results could not be expected when a normal growth, or 1-inch in diameter every three years, was not secured.

The owner should possess a knowledge of forestry before attempting to select trees for harvest and should also be able to estimate the volume of lumber or other wood products in the trees that he plans to cut.

Pines in Mississippi reach financial maturity when they reach the sizes of 16 to 26 inches in diameter depending upon soil site and many other factors. In determining when a good straight sawlog tree is mature and ready to cut, other factors to be considered in addition to its rate of growth and earning power described above, are physical factors. These are: on pines, trees become flat-topped; signs of redheart may be seen; a fungus growth may appear in the form of a shelf-like outgrowth high on the trunk of the tree or a wound or a knot from which resin is running down the trunk; bark may become thin and reddish in color, and dying of branches may be seen in top of trees; on hardwoods, branches dying in top of tree is the most common symptom.

Group selection method. In defining the selection method it was stated that the trees cut at any one time might be standing singly or in small groups. There are certain advantages in maintaining a group-wise arrangement of trees of the same age. Less breakage among younger trees is caused in felling and removing the oldest age class. The cost of logging may be slightly reduced. More light is provided for the development of seedlings and young trees. This is of especial importance in the case of the so-called light-demanding species. Such species should not be managed under a method of single tree selection. An advantage is that the grouping enables the individual trees within each group to grow under conditions prevailing in even-aged stands, thus obtaining greater freedom from branches and more cylindrical stems than might be secured in single tree selection stands.

By varying the size of the group, great flexibility in application is possible. The oldest groups may contain only two to five trees and from this range up to more than a hundred, occupying ordinarily 1 to 4 acres. It is possible that even larger groups can be employed. Where the groups occupy more than a quarter of an acre, the stand tends to lose its uneven-aged form. With larger groups, one of the distinctive characteristics of the selection method is minimized or reduced, namely, the protection afforded the soil and reproduction. The groups should be small enough, so that seed can be distributed in abundance over the cleared area, and so that surrounding trees may conserve soil moisture and shelter or protect reproduction.

Where groups too large for adequate distribution of seed from the side are cut, it becomes necessary either to reproduce the center of the cleared patch artificially or, as is more customary, to leave a few seed trees scattered over the area.

Unless an area basis is used to control the extent of the territory cut over at one time it becomes very easy to over-cut in applying the group selection method.

SEED TREE METHOD

With this method the area is cut clear except for certain trees (called seed trees) left standing singly or in groups for the purpose of furnishing seed to restock naturally the cleared area. Only a small percentage of the total volume, ordinarily less than 10 percent, is left standing as seed trees.

Usually from 4 to 10 seed trees should be left per acre, the number depending on the number of seed produced per tree, weight of the seed, and the conditions under which the seed must germinate.

When enough seedlings to make a full stand become established, the purpose for which the seed trees were left is accomplished. It may pay to remove them at this point if the reproduction is large enough to be beyond danger of destruction by most fires, which may be from 8 to 12 years of age. This would leave the new stand to develop unhampered, to be utilized according to their quality, size and height, for merchantable purposes or for use on the farm.

In some classifications the seed tree method has been included under clear-cutting methods. The leaving of seed trees, together with the fact that the seed supply is furnished by these seed trees standing on the area cut instead of by trees cut in the clearing operation or by trees standing outside the area cleared, warrants the separation into two methods.

As a result of the seed tree method an even-aged stand is produced. There may be a range of 5 to 10 years in age between the young seedlings which start on the cut-over area, but not enough difference to prevent the stand from being even-aged.

It is important that good seed trees be selected. Trees well rooted are not as apt to blow down. They should be old enough to produce abundant fertile seed and tall enough to scatter the seed thoroughly over the area. In selecting pine seed trees to leave, choose good straight trees 10 to 16 inches d.b.h. that have at least one-third of total height in live crown. A tree that will produce at least two 16-foot logs when it is later harvested will earn the best dividends in timber growth.

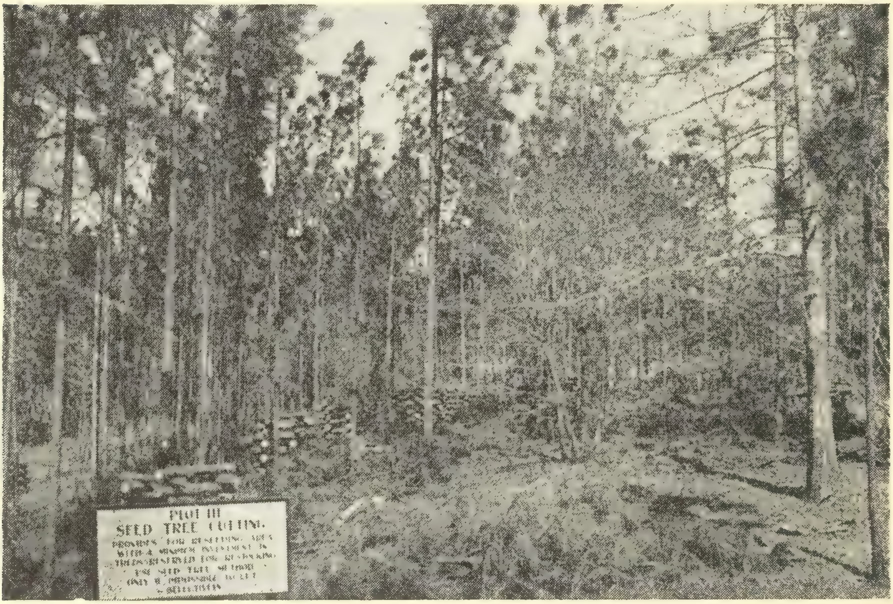


FIGURE 7—When seed tree method of cutting is used at least 4 to 10 seed trees per acre, 10 to 16 inches d.b.h., should be left well spaced over the acre.

CLEAR CUTTING METHOD

In this method the area is cut clear. Reproduction is secured after the cutting, either artificially by seeding or planting, or naturally by seed distributed from trees standing outside the area cleared, or from trees cut in the clearing operations. This method resolves however into either (1) clear cutting with artificial reproduction or (2) clear cutting with natural reproduction.

CLEAR CUTTING WITH NATURAL REPRODUCTION

Here the stand is cut clear and reproduction springs up naturally on the clear area. This reproduction, to secure best results, should start immediately but frequently requires several years. The seed from which the new stand originates comes from two sources:

(a) Trees standing outside (usually adjacent to) the area cleared. The seed are disseminated (by wind) over the cleared area most thickly, close to the parent trees on the borders of the clearing, and in decreasing amount toward the center. Reproduction arising from such seeding is likely to be too dense around the edges and too sparse or lacking altogether in the middle. For best results the cleared area should not be wider than a distance equal to one or two times the height of the adjacent timber.

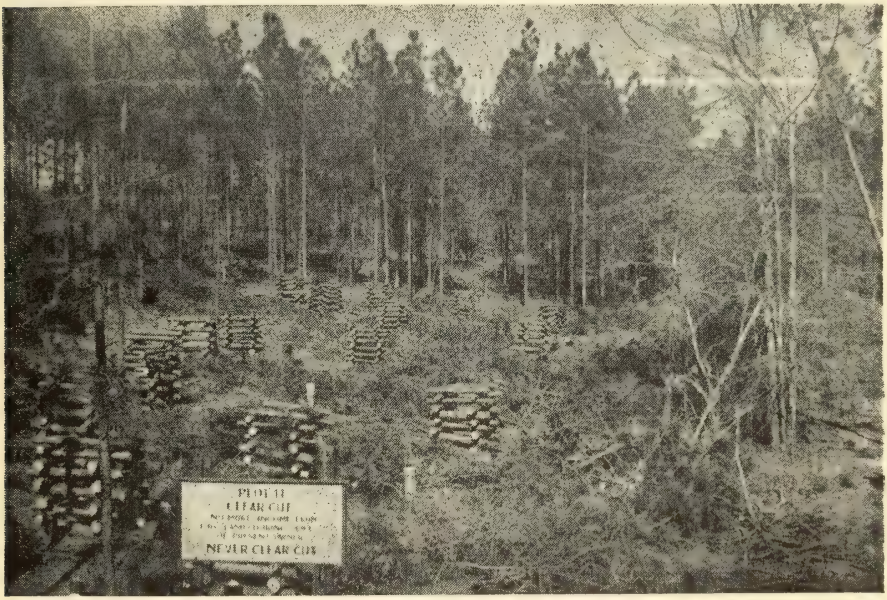


FIGURE 8—Group clear cutting. Never clear cut unless there are enough seed trees adjoining the clear cut strip or group to reseed the area clear cut. The clear cut area should not be wider than a distance equal to one or two times the height of the adjacent seed trees.

(b) Ripe seed on the trees at time of cutting. A uniform and complete reproduction frequently will follow where this source of seed is available on the cleared area.

Successful natural reproduction following a clear-cutting depends first on an abundant seed supply over the entire area and second upon the existence of conditions favorable to the germination of the seed and development of the young seedling. The method involves a sudden and complete exposure of the ground. In order to secure a new crop, the species being reproduced must be capable of establishing itself under these difficult conditions.

Where clear cutting is practiced it may be necessary that one of the following treatments be given the area in order to make conditions favorable for germination of seed and survival of seedlings:

1. *Treatment of live vegetation likely to compete.* Frequently trees of inferior species and low quality are left on a cut-over area. This appears most frequently on clear cut areas. If this is true, such trees with more space will likely develop spreading crowns and hamper and prevent growth of the seedlings and it may be necessary to remove them. However, they might be poisoned or girdled. In some cases, some vegetation such as grasses, shrubs, and other plans offer interference with reproduction.

2. *Treatment of the soil.* Where the soil has been exposed previous to cutting the timber, soil conditions may need to be improved. This may exist where forests are repeatedly burned-over and there is no vegetation or organic material on the ground. Therefore, falling seed lie exposed on the soil which is clean or barren and which may be very hard. In such cases, cultivation with a harrow or similar tool may be helpful.

References: (1) Book by R. C. Hawley, "The Practice of Silviculture" 4th Edition, chapters 3, 4, 5, 6, and 7, John Wiley & Sons, New York, N. Y., 1937. (2) Forestry Terminology (Society of American Foresters 1900), page 23, published by Society of American Foresters in 1944. Compiled and edited by Committee on Forestry Terminology, R. C. Hawley, Chairman. (3) Article by R. R. Reynolds, Southern Forest Experiment Station, "Some Principles of Farm Woodland Management," New Orleans, Louisiana, September, 1941. (4) Mimeograph "1945 Cutting Record, Farm Forestry Compartment 51—Crossett Experimental Forest," U. S. Department of Agriculture—Forest Service, Southern Forest Experiment Station, New Orleans, Louisiana, October, 1945.

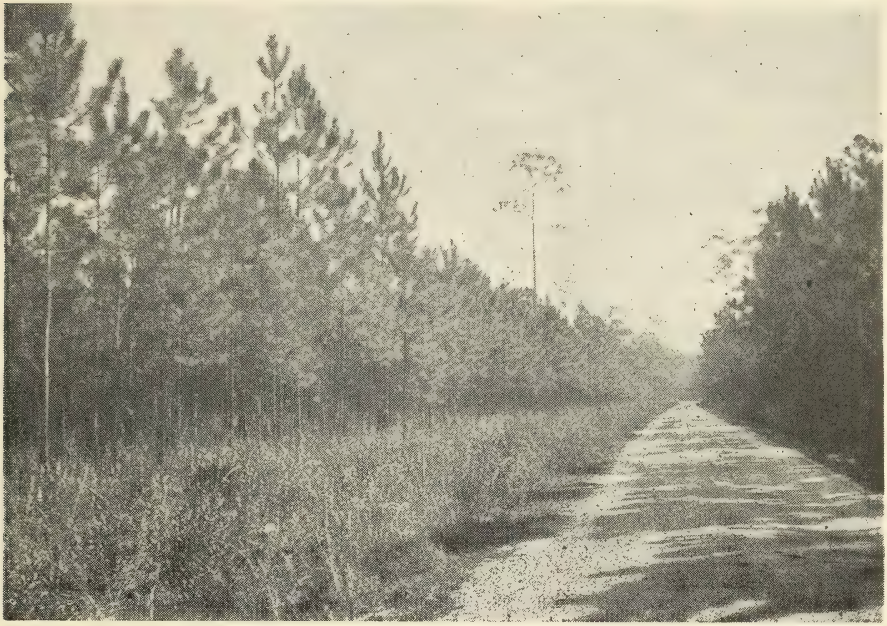


FIGURE 9—Perfect restocking of slash pine in Hancock County.

CLEAR CUTTING WITH ARTIFICIAL REPRODUCTION

Where is is possible, natural reproduction is better than artificial. Certainly it is cheaper and more practical. However, planting is necessary in some cases to maintain or improve existing stands of timber, also where new stands are established on land retired from cultivation or to control erosion.

One important difference between natural reproduction and planting should be emphasized at the start. If, because of a poor seed crop or of drought, natural reproduction fails in any one year despite correct selective cutting of an existing stand, no great harm is done. The seed-producing trees are still there, increasing in size and value, and should still produce seed enough for reproduction another year. In contrast, planting represents an outlay of cash and labor, and if an error in any one of the numerous steps in the planting process causes the plantation to fail, there is no growth going on and no free "second chance"; the only way to get a plantation is by a second expenditure of labor and cash. For this reason practices and results should be checked carefully before planting is planned, recommended, or supervised.

One strong similarity between natural reproduction and planting, too often ignored or overlooked, should also be emphasized at the start. The object of planting and the result of successful planting, is not, as is sometimes assumed, the establishment of some queer, freakish, extra-special kind of forest stand that follows laws different from those of natural stands. On the contrary, the object of planting is to establish a fully stocked, rapidly growing, increasingly valuable forest stand, capable of producing a variety of products over a long term of years.

A thorough understanding of these two-points, the importance of proceeding soundly step by step through the entire planting process, and the fact that the object is to produce a good and readily managed stand, furnishes a sound basis for planning, recommending, and establishing plantations, and should help greatly in acquiring the detailed, locally adaptable information needed to make planting a success.

Factors affecting initial survival. These are of concern largely during the actual planting. The principal ones are:

1. Choice of species for site; of site for species
2. Preparation of site (especially in erosion control).
3. Storage; perhaps heeling-in of stock.
4. The planting itself.
5. Protection from fire; from grazing.
6. Weather. (Planter can merely study this, and allow for the peculiarities of his locality.)

(Planter's responsibility and under his control).

Factors affecting thrift, development and value.

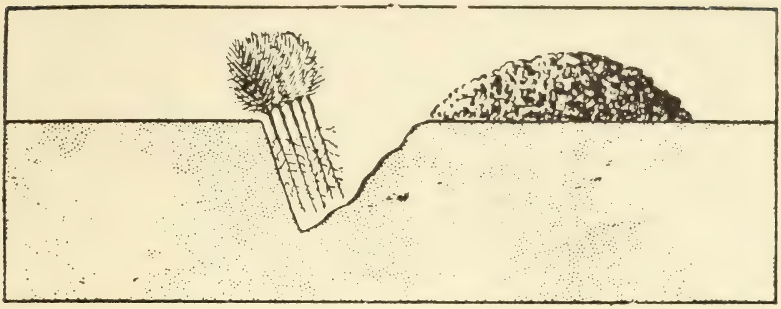
1. Choice of species for site; of site for species.
2. Spacing.
3. Continued protection against fire, grazing, and possibly insects and disease.
4. Cleanings and liberation cuttings.
5. Pruning.
6. Thinnings and improvement cuttings.

(Of major importance when plantations are planned or advised).

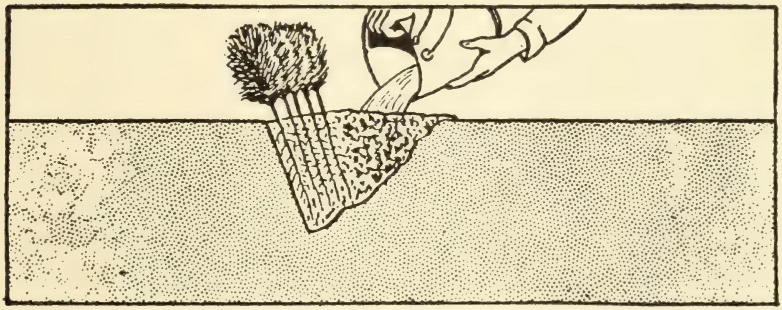
Planting Stock. One-year-old nursery-grown seedlings are preferred for planting. The Mississippi State Department of Forestry maintains a forest nursery from which stock may be obtained free for planting on farms within the State; orders should be placed in late summer or early fall with the area ranger or county agent.

Seedlings that have come up on old fields or along roads near the planting site have been used with good success, especially if grown in full sunlight and transplanted with earth still around their roots. On the whole, however, such wild stock is likely to cost more and to give less satisfactory results.

Digging Seedlings. Where wild seedlings are used by farmers, the seedlings should be dug carefully, the soil falling from the roots gradually so as to cause the least possible injury to the rootlets. The roots should be kept moist at all times and never be allowed to become the least bit dry. If the taproots are long, they should be pruned back to about eight inches in length, using a large sharp knife and a board. If planting is to be done nearby or soon, the bundles of trees are kept moist in wet moss or wet burlap. If not, they should be "heeled" in fresh soil. To do this, a trench is dug in a shaded or cool location with one sloping side, preferably sloping toward the north. The bundles of trees are laid close together and the roots and stems, but not the leaves or tops, are then covered with one thickness of burlap, some brush or soil and if they become dry they should be well watered. In this manner seedlings may be safely kept for weeks. The sooner the seedlings are planted on the site where they are to grow, the better the chance of their survival.



Dig V-shaped trench in moist shady place. Break bundles and spread seedlings out evenly in trench, being careful not to curl or jam roots at bottom of trench.



Fill in loose soil and water well. Complete filling trench with soil, until roots are well covered to the same depth they grew in the nursery, but no deeper. Water "heel-in" bed daily.

FIGURE 10—Heeling-in seedlings.

Sites and species. Much can be learned about choice of land to plant and choice of species by studying the various species on similar soils nearby. Some species of pine can be planted successfully on almost any land formerly in pine and on many farmed-out soils originally in upland hardwoods. It is most worthwhile on good land restocking too slowly (as from lack of seed trees nearby) or requiring a thick cover to control erosion.

When there is doubt about which species to plant, or enough of one species to cover the entire area is not obtainable, it is well to mix two species—preferably an acre of one and an acre of another. Such a mixture may prevent total loss from some insect or disease attacking a single species and is thought to produce healthier, better-formed trees. Use the specie of trees native to the land on which they are to be planted.

Plantation spacing. From studies made of earlier plantations of pine at Bogolusa, Louisiana, by the Southern Forest Experiment Station it was found that:

1. Close spacing *reduces* rate of diameter growth.
2. Close spacing *increases* rate of self-pruning.
3. A closely spaced plantation is easier to mark for thinning than a widely spaced plantation, permits more complete removal of crooked, forked, and infected trees at the first cut, and leaves more trees, better spaced, for later cuts. Close spacing with skillful thinning results in very nearly the ideal of stand management.
4. Wide spacing produces a better turpentine size tree at an earlier age.
5. Wide spacing produces trees of turpentining size at an earlier age.
6. Wide spacing produces trees of pulpwood size at an earlier age.
7. When pulpwood can be cut, however, especially in small sizes or where thinnings can be used for fuelwood, wide spacing does not make as full use of the ground by any means as close spacing, for, say, the first 15 years.
8. Where pulpwood or other small products cannot be cut (as on some extensive industrial holdings), the lack of early thinnings might cause a plantation as close as 5 x 5 feet to suffer serious reduction in growth, become stagnant, and cause waste through the death of suppressed trees.

Slow diameter growth (Point 1 above) counts against close spacing only in that it slightly delays the first cut. It is actually advantageous in that it helps keep the number of rings per radial inch within specifications for structural timber and piling, and, with point 2, in that it confines knots to a small central area.

Rapid self-pruning (point 2 above) seems to apply particularly in the case of loblolly pine, which is often excessively branchy because of attack by tip moth; and of longleaf pine, which starts height growth irregularly, so that at wide spacing the fastest growing trees become limby through insufficient crowding by their neighbors.

The advantage for wide spacing in point 6 (early pulpwood production) is distinctly offset by the disadvantage of incomplete utilization of the land. The 8 x 8 spacing produces a cut sooner than the 5 x 5 if only the trees 6 or 7 inches and up are acceptable for pulpwood, but at the same age produces far less than the 5 x 5 if the trees down to 4 inches d.b.h. can be used.

Recommendations for a spacing of 5½ x 5½, or 5 x 5 feet are strengthened by accessibility to a pulpmill. Where expenditures are being made for fences and firebreaks, recommendations for close spacing are further strengthened by the fact that the costs of fencing, and making firebreaks are pro-rated over more trees. In other words, why have $100.00 worth of fence protect only three-fourths or one-half the merchantable material it can be made to cover?

Even after due weight has been given to the points already discussed, the most important factor in choosing the correct spacing may be entirely overlooked. This factor is *the survival it is reasonable to expect.* Many planters and planting advisors are so obsessed with the cost per thousand trees and the labor of planting them that they forget that the stand they are going to mark and thin will consist only of the trees, perhaps relatively few, that will reach an age of 15 years, or thereabouts, and not of the many trees they buy and plant.

Table 8 shows the number of trees per acre that will be available at the first cut, at various spacings and survival percentages—assuming survival to be measured at 15 years. By reducing these figures 30 percent to 50 per cent an approximate picture of the stand left for further growth and a second cut may be obtained. These figures are a strong argument for close spacing where local experience shows that survival is likely to be low.

Table 8. Number of trees per acre from which first cut may be taken, at various initial spacing and later survivals

Survival	Spacing, in feet				
	5 x 5	6 x 6	6 x 7	8 x 8	10 x 10
Percent					
100	1742	1210	1037	681	436
90	1568	1089	933	613	392
80	1394	968	830	545	349
70	1219	847	726	477	305
60	1045	726	622	409	262
50	871	605	518	340	218
40	697	484	415	272	174
30	523	363	311	204	131
20	348	242	207	136	87

Reference: Paper by Philip C. Wakely, Silviculturist, "Some Principles of Forest Planting on Farms," pp. 3, 7, 10, 11, and 12. Southern Forest Experiment Station, New Orleans, Louisiana, September, 1941.

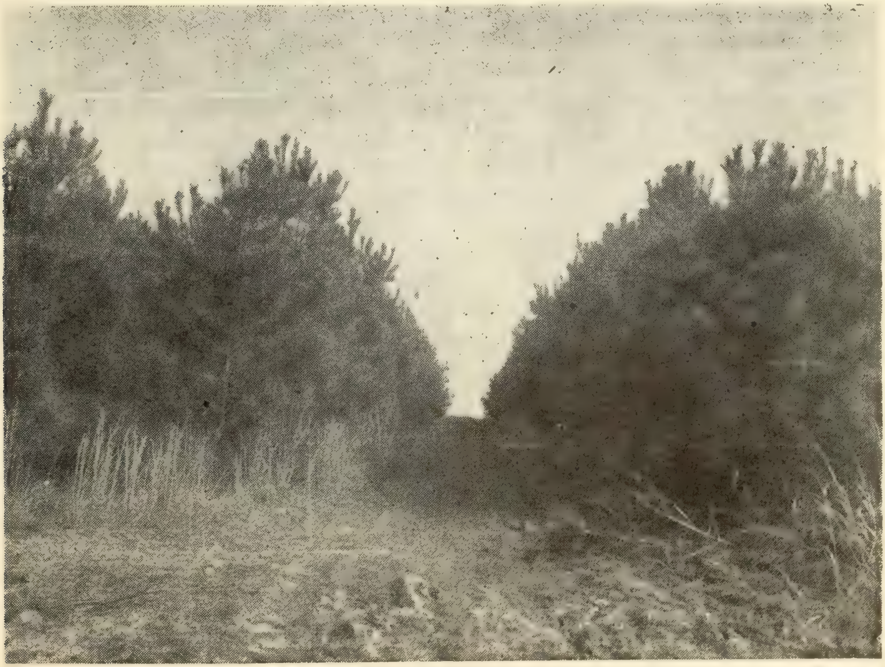


FIGURE 11—An 8 year-old stand of loblolly pine; part of a 200-acre pine plantation, planted on submarginal agricultural land in Madison County. Note the plowed fire land in this picture.

Planting. The essentials of good planting are (1) to keep the roots wet; (2) set the tree with its roots spread out in a natural position; (3) firm or pack the soil in the hole; (4) set the tree a little deeper than it stood in the nursery or field; and (5) draw a little loose soil or leaf litter around the tree as a mulch over the soil.

The trees should be set at regular intervals, 5 x 5 or 6 x 6 depending on spacing desired. Two men make a good working unit, one digging the holes; the other setting the trees, carried along in a bucket containing water, wet moss or wet burlap. One man planting crews may be used very satisfactorily.

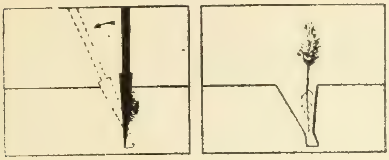
In setting seedlings, take advantage of favorable locations such as small openings, natural soil pockets, close by old logs or stumps and away from heavy shading bushes or trees.

A mattock (mattox or mattax) is a good planting tool. Some grubbing hoes have a blade that is not too wide and therefore suitable. A narrow spade may do well, especially a tilling spade. The hole should be large and deep enough to allow spreading of the roots, including the main taproot, in a natural position. If the main roots are left bent upward in the hole, the trees soon die. The planter should hold the tree in a natural position slightly lower than it formerly stood in the plant bed, and gradually fill the hole by drawing fresh soil in around the roots, meanwhile pressing the soil about the roots with the hands and at least twice with the sole of the shoe. A test of good planting is to pull upward on the stem. The tree should be firm with no upward "give" to the main stem. Some loose soil or leaf litter should be drawn about the tree to act as a mulch in preventing a rapid drying of the soil.

In loose, sandy soil, planting can often be done successfully and cheaply with a dibble or planting bar. This tool, shown in figure 12, is a narrow, thin, flat iron blade of 7/8-inch iron, tapered in a rounding point and attached to an iron rod as a handle. The tree is set by inserting seedling in the slit pushing it down to the bottom of slit and pull back up until seedling is at the same ground level as it was in the nursery. This is to make sure the seedling roots are not turned upward in the slit. The seedling is held in this position by one person while another person sinks the dibble about 4 inches back of the slit, presses backward to close bottom of the slit then forward to close the top. It is sometimes advisable to repeat this process in light soils to get the slit properly closed. To complete the planting operation the dibblemen's right heel is thrust into the closed slit back of the planting seedling to close up any air pocket around the roots.

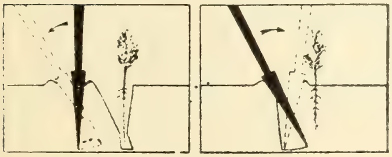
After workers get accustomed to the method of planting, a crew of two men or boys working in loose soil should set out from 900 to 1,200 trees, or up to an acre in a day.

Procedure and details for planting seedlings with both planting bar and mattox are shown below in figure 12.



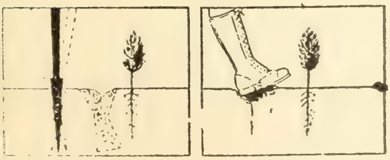
Insert bar as indicated; and pull back to free blade, leaving hole deep enough for root length, far side of hole straight and undisturbed. Keep seedlings in a bucket with plenty of wet moss around the roots. Remove one at a time to plant.

Place seedling at same depth it grew in nursery, seeing that root is not crooked at bottom of hole, and that lateral roots are spread uniformly.

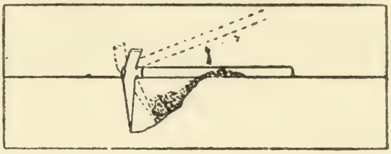


Place bar at angle about three inches from seedling, pressing handle back to close bottom of hole

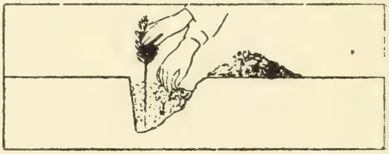
Push bar forward to close top of hole, and to firm soil around roots.



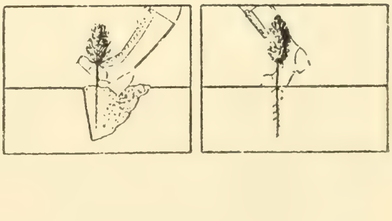
Close the back hole and firm the disturbed soil with heel.



Insert mattock, pulling up, then back, to remove soil and form hole with one straight side, deep enough for full root length.



Place seedling against straight side, at correct depth, with roots spread, and push loose soil around roots, packing the dirt as the operation proceeds.



Finish firming soil with foot, packing well so that soil particles will be in contact with feeder roots.

FIGURE 12—Two methods of planting seedlings.

Protection of plantations. Protection of seedlings from fire, livestock, diseases and other injuries is very necessary to successful survival and growth. This is more important during the first few years after planting. Detailed discussion on these injuries, controls, etc., are found in part VIII of this bulletin, entitled, "Forest Protection."

References: (1) United States Department of Agriculture Leaflet 159, "Planting Southern Pines," pp. 2, 3, 4, and 8, Washington, D. C., 1938. (2) United States Department of Agriculture Bulletin 1517, "Loblolly Pine Primer," pp. 12, 17 and 33 to 38 inclusive, Washington, D. C., December, 1926.

Reclaiming eroded land with trees. The amount of erosion on land well stocked with forest is amazingly low compared to that devoted to row crops or even pasture or barren land. Too, a reduction in erosion, other factors being equal, means greater absorption of water by the soil in inverse proportion to the amount of erosion, which in turn provides more moisture for crops on the land.

Certain lands in Mississippi have eroded to such an extent, or have such slope and soil types that they will not produce any other crops, excepting forests, economically. If the former situation exists and yet the slope and soil type is such that it would produce good yields from row crops when erosion is controlled, the land might be put to forests for a period of time and then back to row crops.

A study was begun by the Southern Forest Experiment Station in 1929 in the silt loam uplands east of the Mississippi River, comprising an area about 500 miles long, and 35 to 100 miles wide. This area includes all of the brown loam section of Mississippi and an additional strip of land on each side as well.

Detailed plots were established in 1931 on areas near Holly Springs, Mississippi, all differing as to cover type and land use. A summary of these results are shown below, as well as a summarized discussion of same.

Table 9. Total surface run-off and water absorption in relation to precipitation with various land uses, Holly Springs, Mississippi, October, 1931 to September, 1933

	Plot							
	Oak forest 1/	Broomsedge field 1/	Black locust, Osage-orange plantation	Bermuda grass pasture	Scrub-oak woodland	Barren abandoned land 2/	Cultivated land (cotton)	
							Rows on contour	Rows on slope
Number rains 3/	103	103	97	92	102	103	103	99
Total precipitation, inches	134.21	126.50	112.05	105.66	127.54	129.21	131.38	126.89
Quantity of rainfall that:								
1. Was absorbed								
A. Inches	133.18	125.12	109.85	101.68	117.52	67.51	69.68	53.04
B. Cubic feet per acre	483,443	454,186	398,756	369,098	426,598	245,061	252,938	192,535
C. Percent	99.23	98.91	98.04	96.23	92.14	52.25	53.04	41.80
2. Run-off								
A. Inches	1.03	1.38	2.20	3.98	10.02	61.70	61.70	73.85
B. Cubic feet per acre	3,739	5,009	7,986	14,447	36,373	223,971	223,971	268,076
C. Percent	0.77	1.09	1.96	3.77	7.86	47.75	46.96	58.20

1/ Run-off and erosion data based on average of duplicate plots for the first 6 months of the study.

2/ Run-off and erosion data based on average of duplicate plots for the first 14 months of the study.

3/ Differences shown are due to the fact that on 4 plots experimental conditions were seriously disturbed caused by a few heavy rains, data for these storms being omitted because of their incompleteness or inaccuracy.

Table 10. Soil erosion during the 2-year study period

	Oak forest	Broomsedge field	Black locust Osage-orange plantation	Bermuda grass pasture	Scrub oak woodland	Barren abandoned land	Cultivated land (cotton)	
							Rows on contour	Rows on slope
Total rainfall, inches	134.21	126.50	112.05	105.66	127.54	129.21	131.38	126.89
Total run-off, inches	1.03	1.38	2.20	3.98	10.02	61.70	61.70	73.85
Soil lost:								
Per plot, pounds	0.075	.305	1.676	.311	1.089	263.961	114.600	322.472
Per acre, pounds	91	369.00	2,028	376	1,318	319.393	138.666	390,191.00
Tons	0.05	.18	1.01	.19	.66	159.70	69.33	195.10
Relative quantities of soil eroded 1/	1	4	22	4	15	3,519	1,528	4,300
Rainfall required to erode one pound of soil per plot—inches	1,789.47	414.75	66.86	339.74	117.12	.49	1.15	.39
Surface soil eroded, inches	0.0003	.0011	.0062	.0012	.00	.9446	.4244	1.1943
Years required at existing rate to erode 6 inches of top soil	40,000	10,909	1,935	10,000	3,000	12	28	10

1/ In terms of the minimum quantity of soil eroded from any plot.

The soil loss from the black locust plantation was undoubtedly smaller than the data indicated; disturbances on this plot during the first 5 months of the study caused abnormal erosion, as is indicated by the fact that almost 50 percent of the total soil loss occurred during that period. Soil losses from the barren and cultivated plots were enormous, and were proportionate with the run-off from these plots.

The ratio of the soil lost from the two cultivated plots to that lost from each of the oak forest plots was 4,300 to 1 and 1,528 to 1. The barren plots lost 3,519 times as much soil as did the forest plots. The erosion rate during the 2-year period indicates that the enormous rainfall of 1,789 inches would be required to erode a pound of soil from a forest plot, but that less than one-half inch rainfall would be required to erode a cultivated plot with rows on a slope. The stability of the soils having a plant cover is further illustrated by a calculation as to the number of years needed to erode the upper 6 inches of surface soil under the different systems of land use.

During the 2-year period, the indicated run-off from an acre of cultivated land totaled 6 acre-feet, while run-off from an acre of forest land amounted to but little more than 1 acre-inch.

The ability of soils having a forest or grass cover, to absorb practically all the rainfall demonstrates that such vegetation is very valuable in the storage and holding of water that would otherwise be destructive.

That forestry, pasture development, and the production of forage cover crops are types of land management deserving wider usage is also implied by the results of this study.

The study has disclosed evidence on several points relating to forest management. The data indicate that an inferior cover of scrub oak possesses distinct value for the protection of watersheds. They bring out also the extent to which the protective efficiency of forest cover can be reduced by annual fires and other abuses. Thus the scrub oak stand, which has replaced old-growth oak forest, permitted a soil loss 15 times as great as that permitted by normal forest cover and a rainfall loss by direct run-off 10 times as great. A cover of black locust and Osage-orange, established less than 23 years previously, was found to have converted an eroded abandoned field into a stable site capable of absorbing 98 percent of the rainfall. Analysis of the soil of the planted area showed 3 percent of organic matter in the upper 6-inch layer or in the same proportion as occurs in the corresponding layer of virgin soil under oak forest.

Reference: United States Department of Agriculture Circular 347, "Effect of Cover on Surface Run-Off and Erosion in the Loessial Uplands of Mississippi," by H. G. McGinnis, Silviculturist, pp. 10, 12, and 13, Southern Forest Experiment Station, Division of Research, Forest Service, Washington, D. C., June, 1935.

PART IV

HARDWOOD TIMBER

Hardwoods are important in certain sections in Mississippi. This is true in the Delta counties, the larger river bottoms of the State, and in the brown loam counties. They thrive well on most bottomlands, in fact to the extent that they crowd out the pine timber. Since they are better adapted to bottomlands than pine trees, it is important that farmers know how to manage hardwood forests in order to derive most from hardwoods where they are grown.

Roughly estimated, 40 percent of the Delta's 4.2 million acres of land is in woods; or about one and one-half million acres. The bottomland forest area of the Mississippi Valley totals 13½ millon acres out of the South-wide total of 28 million. The major portion of the Delta forests is in the backwater area above Vicksburg, along the Mississippi River on lands not protected by levees, and in the poorly drained interstream depressions or valleys. Eighty percent of this acreage is held by owners of cotton plantations, with more than two-thirds of it in holdings less than 1,000 acres. With the exception of the backwater area there are few unbroken forest areas remaining.

"Southern Forestry, A Study of the South's Renewable Natural Resources," prepared and published by the Illinois Central System, has this to say about hardwoods: "No single species of Southern hardwood has the economic importance of the pines, but taken together the hardwoods support important and substantial lumber, flooring, millwork, furniture, plywood, cooperage, box, and related industries in the South."

Just as it takes a long time to rebuild exhausted soils, so does it take years to produce a new crop of timber when you have to begin with seedlings. Growth rates, management, sales, in the relatively short period of 5 years, have already proven we can take the woods we have and make them pay their way as they are restored to sustained, quality yield.

There are innumerable practical things correlated with management that the average farmer can do, based on the research work at Stoneville Branch Experiment Station. An outstanding example is the utilization of poorer species for fence posts after preservative treatment.

The hardwood forest at Stoneville is typical of much of the woods of the entire Delta; the actual cutting and utilization is typical of what might be done on any plantation, and the results are typical of what the average landowner might expect from forest farming. To this, however, might well be added a word of warning from Mr. Maisenhelder, Delta Unit Forester, "Even though the Delta Experimental Forest is typical of most of the Delta woods, unfortunately there are some areas in worse condition and owners of the latter areas cannot expect as good returns as we have had."

RESULTS OF RESEARCH

A special study was started several years ago by the Agricultural Experiment Station, at Stoneville, Mississippi, in cooperation with the Southern Forest Experiment Station, New Orleans, Louisiana. This study with its various phases covered the entire woodland area of the Mississippi Delta.

Tree cutting in the Delta some 30 years ago was done to take out sawlogs; even then, only in certain varieties. Since that time, continued carelss logging, fuelwood cutting, and fire, have destroyed a large part of our woodlands. However, at Stoneville, since 1939, tree cutting has been done for the purpose of improving the quality of a growing forest in an attempt to bring back to productivity and beauty a typical Delta bottomland woods. The growth in the Delta Experimental Forest was originally logged about 1913 and up until October, 1939, had been burned over frequently and had suffered all the abuses of trespassing. Consequently, the woods were full of relatively worthless trees, and very poorly stocked with trees of good quality and high value. The tract before 1939 was, unfortunately, typical of the majority of our woodlands today.

GROWTH RATES

The improvement cutting that has taken place on over 2,000 acres at Stoneville, include some 24 different tree species. However, since the stands were not fully stocked and since the test is not old enough, it is impossible to show at this point the value of proper management in hardwood forests. Research indicates, however, that with proper management, the Delta hardwood forests' annual production could be increased from the very low rate of 119 board feet per year per acre up to 300 or maybe as much as 500 board feet.

COMPARISON OF INCREMENT AND DRAIN

During the years 1932 and 1938, the volume of saw timber and growing stock decreased about 2 percent. The matter of timber size, timber quality, and maintenance of a desirable proportion of more valuable species was less favorable. More than half of the sawtimber drain was the manufacture of lumber, veneer, and cooperage, and came largely from the stock of higher-quality timber of the more valuable species. Even for other uses, the general practice is, and has been for a long time, to select the better trees for cutting and to leave trees of low quality and less valuable species. Regardless of the seasons back of such practice, the result of it is reflected in a high proportion of low-grade trees and less valuable species in many of the present stands. Reversal of this trend will depend largely on the extent to which timber comes to be handled as a crop instead of as something that just grows.

From 1932 through 1937, the saw-timber drain on the growing stock has tended to increase. From a surplus of growth over drain of 23 million board feet in 1932, the situation has shifted to deficit of growth of 68 million board feet in 1937. In 1938, owing to a sharp decline in commodity drain arising from lowered demand, this trend was reversed. Since then, however, and particularly in 1940, it is estimated that the deficit of saw-timber increment in relation to drain is higher than it was 3 years previously.

IMPROVEMENT CUTTINGS

As a result of the above mentioned study, directions were developed for making improvement cuttings.

SETTING UP CUTTINGS STANDARDS

There are no hard and fast rules for the making of improved cuttings. In general terms, poor trees are cut and good trees are left. Since these terms are very indefinite, some cutting rules or recommendations should be followed as a guide in making such cuttings.

First, however, there are some considerations that affect the decision as to whether or not any given tree should be cut in an improvement cutting, namely: (1) species, (2) size, (3) form and quality, (4) vigor and thrift, and (5) position and space occupied. These five considerations are discussed in order below.

Species. There are many separate species of trees in most bottomland hardwood forests and they are best considered in three separate groups, namely: "best", "intermediate", and "poorest", based primarily upon commercial values. These species are listed below according to this grouping.

Poorest species (weeds)	Intermediate species	Best species
Box elder	Overcup oak	Bottomland red oak
Hawthorn	White elm	Willow oak
Waterlocust	Rock elm	Water oak
Planertree	Winged elm	Cherry oak
Ironwood	Hackberry	Cow oak
Swamp privet	Willow	Cottonwood
	Red maple	White ash
	Sweet pecan	Green ash
	Bitter pecan	Redgum
	Hickories	Persimmon
	Honeylocust	Mulberry
	Sycamore	Cypress
	Blackgum	
	Swamp cottonwood	

Size. Two size classes are considered here: Under-sawlog size and sawlog size. The boundary line between these two classes is set arbitarily at 14 inches d.b.h. and a good lower limit in an improvement cutting is about 5 inches, d.b.h.

Form and quality. The goal of management here is assumed to be production of straight, high-quality logs, suitable in large sizes for lumber and veneer, and small sizes for cooperage, etc. These are logs for which there is a good market and are referred to as high grade logs.

Vigor and thrift. From this standpoint, there are two classes of trees that always should be removed in an improvement cutting: (1) "poor risks", and (2) "over-mature trees". A "poor risk" is a tree containing good material that is unlikely to live until the next improvement cutting is made. An "over-mature tree" is one that has already attained large size for its species and shows some evidence of decreases in vigor and quality. This may be recognized by slower growth rates, scanty and pale foliage, crowns with large dead branches at the top.

Position and space occupied. This consideration is important mainly where most of the trees are desirable. Only three classes of trees need be considered here: (1) trees with poor growing space—those that are overtopped by others or seriously crowded by trees of similar or large size; (2) trees that interfere with better trees—those so closely spaced as to prevent best development of better individuals; and (3) wolf trees—those with unusually large crowns occupying excessive space and which usually are of low quality and have short trunks.

CUTTING RULES

It is impossible to make a specific statement as to how far to go in removing undesirable trees. It may be determined by the size of the area to be improved and the extent to which the forest products can be used or sold. However, the principle that the poorest trees should always be removed first, seems to be applicable in all cases. In the suggested cutting rules presented below, it is probably best to make the first cutting light, removing only the very poorest trees. If a heavier cutting seems desirable, the second set of rules might be used. For a still heavier cutting, the third set of rules should be added. Going beyond this point is probably inadvisable except under certain conditions such as the immediate need for a large volume of wood per unit of area or where the stand is well or over-stocked. If such a cutting is made, the fourth set of rules should be used.

Trees cut according to the suggested rules below should be cut into products of greatest value or use. Trees that are of no value or use should be girdled or poisoned.

Cut first: (1) poor risks, (2) trees seriously decayed or grubby, hence likely to decrease in value, (3) over-mature trees, which have passed their optimum development and should be harvested before further deterioration occurs, and (4) sawlog-size trees of the poorest species that do not contain at least one high-grade log, and of intermediate species that do not contain at least one usable log.

Cut second: (1) Trees of the poorest or intermediate species, regardless of size that do not or will never contain at least one high-grade log and are either (a) wolf trees (occupying excessive space), or (b) trees that will have poor growing space even after the improvement cutting. (2) Trees of the poorest or intermediate species that interfere seriously with the growth of better trees (a) of the best species at least 4 inches in d.b.h., or (b) of intermediate species at least 6 inches in d.b.h.

Cut third: (1) Remaining sawlog-size trees of the poorest species regardless of position or quality. (2) under-sawlog size trees of the poorest or intermediate species that interfere seriously with the growth of better trees (a) of the best species at least 1 inch in d.b.h. or (b) of intermediate species at least 4 inches in d.b.h. (3) Sawlog-size of intermediate species that do not contain at least one high-grade log, or that are very large wolf trees not containing more than one high-grade log. (4) Under-sawlog-size trees of the best species that (a) will never contain at least one high-grade log and will have poor growing space even after improvement cutting, or (b) interfere seriously with better trees of intermediate or best species at least 4 inches in d.b.h. (5) Wolf trees of the best species that do not or will never contain at least one high-grade log, or more than one high-grade log if more than 20 inches d.b.h., *unless* needed for seed, and (6) sawlog-size trees of the best species that do not contain at least one usable log, *unless* needed for seed.

Cut fourth: (1) Remaining under-sawlog-size trees of the poorest species; (2) remaining under-sawlog-size trees of intermediate species that will never contain at least one high-grade log; and (3) remaining trees of the best species that do not or will not contain at least one merchantable or usable log, *unless* needed for seed.

COTTONWOOD PLANTING

Cottonwood is in demand for a great variety of uses and usually brings a good stumpage price. Rapid growth and relatively high value makes cottonwood a very desirable tree to grow in plantations.

Idle lands cost money as do those areas badly in need of reforestation. The Delta needs a tree to put these acres into production. Because cottonwood produces wood faster than any other tree in the Delta and is a general purpose wood that finds a ready market as lumber, pulpwood, and for other purposes, the propagation of cottonwood by cuttings and seedlings has been a subject of intensive study since 1937 at the Stoneville Branch Experiment Station.

Farmers who have marginal or submarginal agricultural lands that need to be planted to trees or who own batture lands will be interested in the bulletin, "Planting Cottonwood on Bottomlands", published by the Mississippi Agricultural Experiment Station, State College, Mississippi, and prepared by Henry Bull and H. H. Muntz. Recommendations on planting are summarized in the above-mentioned bulletin as follows:

"(1) Plant only on bottomland sites that are neither extremely dry in the late summer and fall, nor deeply flooded in the winter and spring. Sites so sandy and dry or so low and often flooded, that they support little or no natural vegetation, are not suitable for cottonwood.

"(2) Plant at 6-foot intervals in plowed furrows 10 feet apart. If the planting site is densely covered with undesirable vegetation, burn or disk the area before plowing.

"(3) Plant during the winter, when cottonwood is dormant, preferably in February.

"(4) Plant 1- or 2-year-old cottonwood seedlings collected from natural stands or grown in nurseries. Trim the roots to a length of 15 inches or less (to a point where the taproot is stiff enough to insert in the planting hole), and the tops to 10 inches. Make 20-inch cuttings from the tops thus cut off.

"(5) Plant seedlings with a rod that makes a hole ½-inch in diameter and 15-inches deep. Plant cuttings [1/] to the same depth with a rod that makes a hole ¼-inch in diameter, or if the ground is soft simply push them in.

"(6) Release the trees from the competition of other vegetation at least once and preferably twice during their first growing season by hoeing away all vegetation within about 18 inches of each tree before it is overtopped.

"(7) Protect the trees from fire and grazing."

Those carrying on these studies believe that the main problem now is one of developing a cheap and satisfactory means of cultivation during the first year after planting in order to eliminate weed competition. Trees of pulpwood size can be grown on favorable sites in about 10 years. One planter of the Delta has a small cottonwood plantation with a survival of above 80 percent.

To complement the regeneration work on cottonwood, tests are now underway on various methods of producing cottonwood planting stock at low cost. Unless a convenient source of natural seedlings is available, nursery-grown cuttings from closely planted rootstocks appear now to hold the greatest promise.

[1/] More recent studies at Stoneville favors the use of cuttings made from 1- and 2-year-old cottonwood seedlings. The cuttings are made about 19 inches long with 15 inches planted below ground level leaving 4 inches above ground.

References: (1) A report prepared by Delta Council, Stoneville, Mississippi, on Bottomland Hardwood Research and Utilization, "Delta Bottomland Hardwoods," August, 1945, (2) Forest Survey Release No. 53, "A Progress Report by the Southern Forest Survey," Southern Forest Experiment Station, New Orleans, Louisiana, June 1942. (3) Occasional Paper No. 93, "Improvement Cuttings in the Bottomland Hardwood Forests of Mississippi" by J. A. Putnam and Henry Bull, Southern Forest Experiment Station, New Orleans, Louisiana, October, 1940. (4) Bulletin No. 391, "Planting Cottonwood on Bottomlands," page 4, Agricultural Experiment Station, State College, Mississippi, August, 1943.

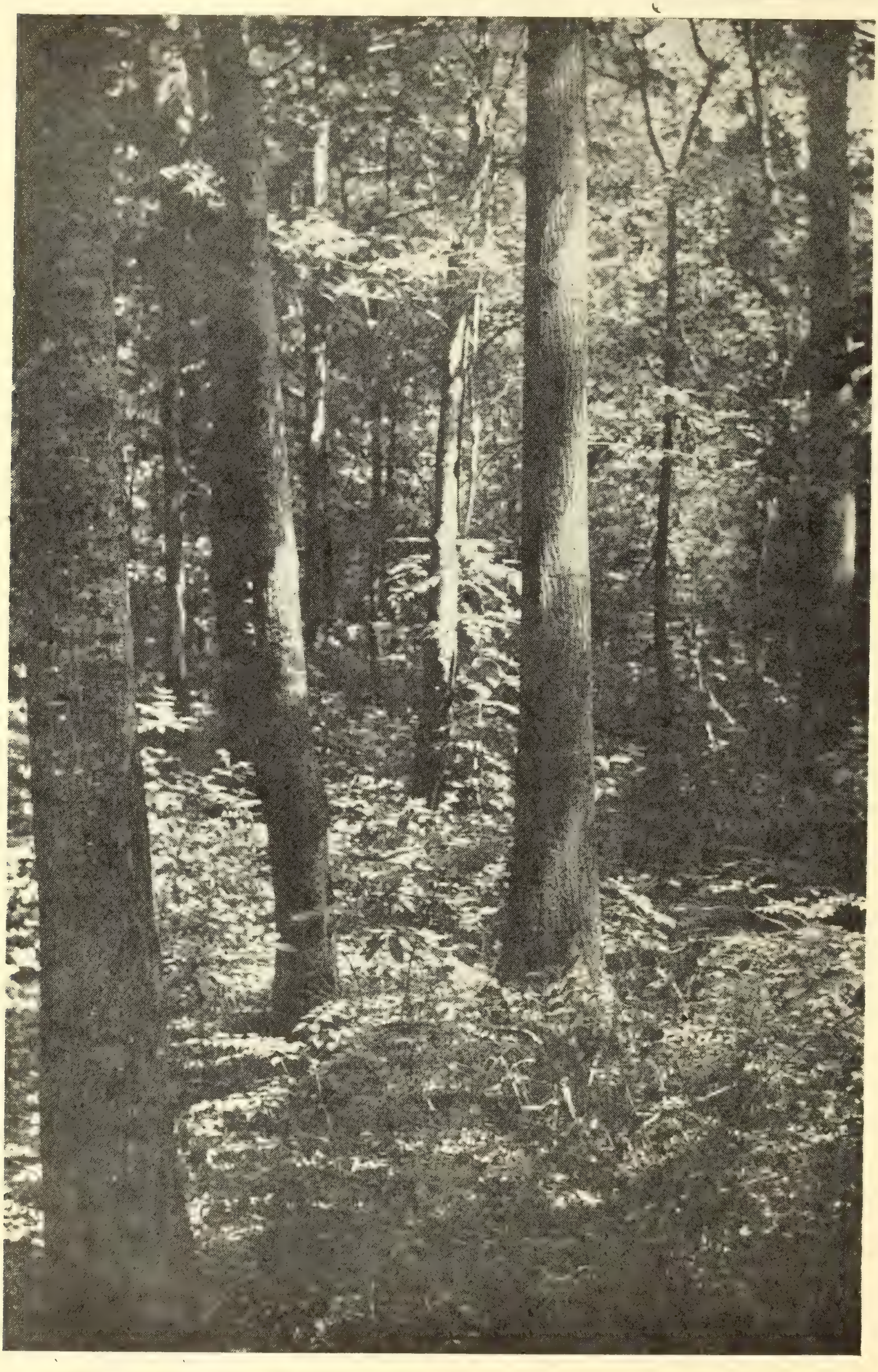


FIGURE 13—Good stand of hardwood timber, Photo—So. Forest Expt. Station, Delta Branch, Stoneville, Mississippi.

PART V

NAVAL STORES PRODUCTION

It is generally known that the outmoded but unshed name of the naval stores industry was derived from the former uses of its products for caulking wooden ships and for preservative treatment of their rigging.

Pines and some other cone-bearing trees, when wounded, exude a mixture of turpentine and resin acids. The mixture is an oleoresin or crude gum. This gummy fluid is not the sap of the tree; it is a secretion found in a network of minute openings called resin ducts. When crude gum is heated, the turpentine is distilled off and the residue, upon congealing, forms rosin. In former times, when rosin was considered almost worthless, crude gum was called crude turpentine or simply turpentine, and the volatile fraction of the gum was known as spirits of turpentine.

Gum or crude turpentine is a valuable and important product of certain species of pine in Mississippi. In recent years, especially, farm income in certain counties in the southern area of Mississippi has been materially increased through naval stores production, particularly where good turpentining practices were used. This has been particularly true during the past several years with advanced prices of crude gum. This phase of forest industry will probably become more important in the future with the growing scarcity of turpentine timber.

LONGLEAF AND SLASH PINES—GUM PRODUCERS

There are only two species of pine in Mississippi that produces crude gum economically, namely, longleaf and slash.

Longleaf pine possesses two qualities which make it a profitable forest tree in Mississippi: (1) It grows on the driest and deepest sandy soils and on wet lands. (2) It withstands to an uncommon degree the injurious effects of fire.

Slash pine excels all other native pines in quantity of gum which flows from the trees when chipped. Its gum, when freshly exuded, is clear and about the color of light-yellow honey. As compared with longleaf or "hill" yellow pine, its nearest competitor, slash pine yields from its dip and scrape combined, a slightly higher percentage of spirits of turpentine and a higher grade of rosin. In contrast to longleaf it produces only a little scrape.

SELECTING TURPENTINE FARMING AS A BUSINESS

Before a farmer goes into turpentine farming he should consider the following:

1. *Determine whether or not timber is suitable for turpentine purposes.* In all cases when it is planned to place timber into naval stores production, it should first be determined whether or not the timber is suitable for turpentining purposes. Several factors should be considered in reaching this decision, among which are:

A. *The class of timber.* Only longleaf and slash pines should be used. A comparison of the value of an acre for sawlogs, poles, and pulpwood, at its stands, should always be made with its value for the same purposes after having been worked for turpentine, to determine whether or not the turpentine profits will equal or exceed the reduction of the timber value for other purposes.

B. *Accessibility.* Timber highly suitable for turpentine is often found in almost inaccessible swamps and bays. Such timber should not be cupped because high water may prevent its being worked for a portion of the season, and the hauling costs may become prohibitive during such times.

C. *Density of stand.* Area being worked for turpentine at the present time averages 19 faces per acre. This average includes the entire acreage, both hill and swamp lands. Areas affording less faces per acre is probably not ripe for turpentining, and should be left until more trees come into the diameter specifications. A farmer who plans to do his own work may cup a more scattered area than if he must hire the work done, due to the reluctance of turpentine labor to work scattered areas. This is particularly true where the labor is paid on a piece-work basis (per thousand faces or per barrel of dip).

2. *Determine whether or not landowner is in position to go into turpentine farming.* In deciding this point careful consideration should be given the following factors:

A. Time to do necessary work or supervise same. It is essential that timber be worked regularly to obtain maximum yields. Therefore timber owners not having sufficient time to do this or to properly supervise the work should not attempt gum farming. It is undesirable to streak timber every 3 to 4 weeks, and spend the remainder of the time working other farm crops. In no case should more than 2 weeks elapse between streaks.

B. *Financial condition.* It requires a considerable and immediate cash outlay to go into turpentine farming. It is, of course, necessary that farmers be in a position to finance the business.

C. *Availability of market.* Markets should be near enough to the producer so that the cost of hauling to market will be within reason. It is also true that several markets within reach create keener competition for gum, sometimes resulting in higher prices to the farmer.

D. *Transportation or hauling equipment.* In the event the farmer does not own a truck with which to haul his gum to market, he should build a small ramp on the best road of his forest and bunch his barrels of dip there by means of a wagon or "slide", to be picked up by the truck engaged to do his hauling.

YIELDS OF CRUDE GUM

The long-range production trend has been definitely downward, and is due largely to a combination of two factors: (1) decrease in the size and number of trees available for turpentining; and (2) increasing competition from other raw materials, notably mineral spirits and wood naval stores products.

In today's scattered stands, the turpentine worker spends approximately two-thirds of his time walking from tree to tree. He can chip an average of only 5,000 faces per week, as compared to the 10,000-face crop which his grandfather worked in the more fully stocked virgin forests of his day. Moreover, because the timber is considerably smaller than in the virgin forest, the yield per tree is much less. Thus, because of decrease in tree size and number per acre, the season's production of each turpentine chipper has fallen to not more than one-quarter of what it was 50 years ago.

TURPENTINE ORCHARDS COMPARED WITH NATURAL STANDS

The scattered second-growth stands of the turpentine belt average about 20 working trees per acre. Although fire protection, turpentining and cutting practices have improved in recent years, progress toward better stocking has been slow. Most of the timber is handled according to a naval-stores-dominated system of management which is not conducive to the building up or maintenance of well-stocked stands of slash and long-leaf pines. The trees are relatively small, averaging only 11 to 12 inches in diameter at breast height, because of almost universal tapping as soon as they reach 9 inches in diameter. Gum yields are accordingly low, averaging about 8.3 pounds per tree per year. Per acre production thus amounts to only 166 pounds of gum per season.

Further inefficiency results from the wide range in tree sizes found in the average stands. The larger trees generally produce more gum and fill their cups faster, so to avoid loss from overflow from these trees the entire crop must be dipped long before the majority of the cups are full of gum.

Thus, the large amount of unproductive walking time, the necessity for frequent gum collection, the low yields per tree and per acre, all tend to lower efficiency and increase production costs in the average natural second-growth forest.

Plantations of slash pine have made excellent growth on abandoned fields of low fertility. Trees that were planted on such areas in 1930 are now being worked for naval stores under regular commercial operating procedure. Plantings on better sites would come into production much sooner.

Assuming that with a planting of slash pine, 12 x 12 foot spacing, and that 80 percent of the trees would survive and attain workable size at about the same time, a planted turpentine orchard should have at least 242 trees per acre. This is more than 12 times the number of working trees in the average natural forest at the present time.

SUMMARIZED STATEMENTS AND CONCLUSIONS ON TURPENTINE PRACTICES

In 1923 a number of experiments were started by the Southern Forest Experiment Station at Starke, Florida, for the purpose of determining the best naval stores practice in second-growth slash and longleaf pines, the two species that are the main source of naval stores in the United States. The practice so determined should supply the definite information needed to avoid the severe damage to timber stands wrought by present and past turpentining methods and to combine profitable, sustained turpentining with timber conservation.

Summarized statements and conclusions as to the results of these experiments are given below.

The principal studies were undertaken in dense second-growth, 35-year-old slash pine and open 25-year-old, second-growth longleaf pine.

The height-of-streak test, in which three heights, 0.32, 0.5 and 0.73 inch, were tried out, revealed the following advantages in favor of low chipping:

Low chipping produces fully as much gum in 5 years' time as higher working.

Low working permits the continuous chipping of one face on trees 11 or more inches in diameter for 10 to 12 years, whereas, moderately chipped faces are worked out in 7 years and high-chipped faces in 5 years.

This additional working should furnish from 25 to 50 percent more gum for each face.

The longer working period provides a longer healing period before back facing is begun and avoids the delay of a long rest period before back faces can be put on.

In naval stores management the longer working period allows for sustained operation without interruption, yielding greater returns at lower operating costs.

Where timber is soon to be cut and only a short working period is permitted, low chipping reduces damage to the butt log nearly 50 percent over that resulting from high chipping.

The low streak results in a smaller amount of damage from dry facing.

The depth-of-streak tests comprised four depths, 0.3, 0.5, 0.75, and 1 inch. The dense slash timber suffered a greater amount of damage than would have occurred in more open stands. The results obtained in this test revealed the following advantages in favor of shallow working:

Although different depths of streak produce no significant difference in total gum yield from 5 years' working, a greater reduction in yield from year to year accompanies the deeper work, indicating a considerably lower total yield for deep chipping if the work be extended to 7 or more years .

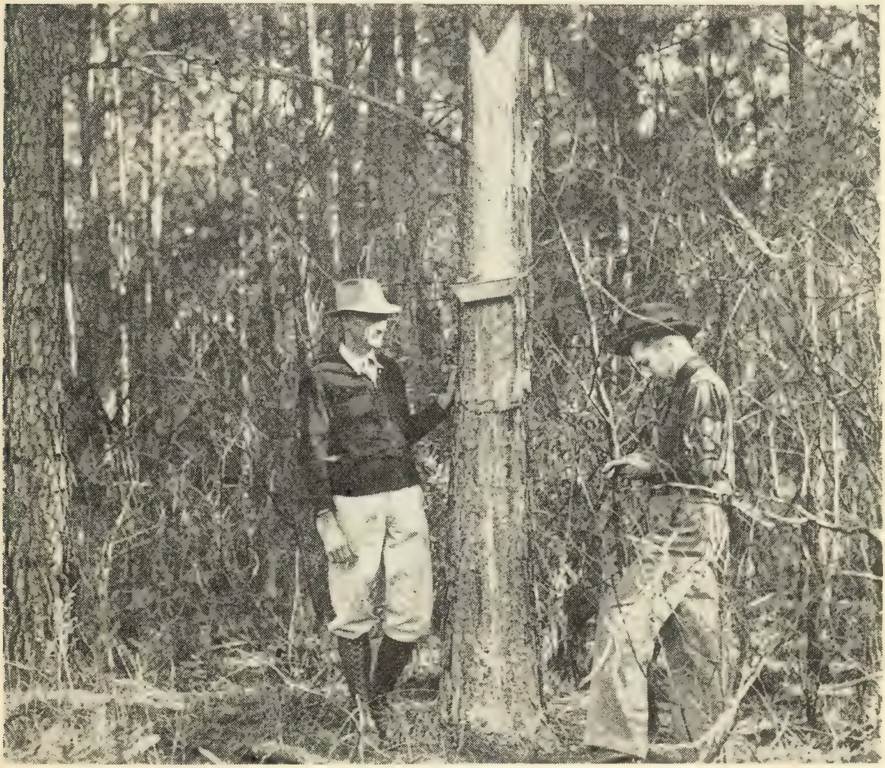


FIGURE 14—The slash pine above is 10 inches in diameter at 15 years of age. Note change from Number 1 to 00 back.

Eleven-inch or larger trees may be worked with shallow streaks for 7 years (or even longer with lower streaks) before the gum yields are reduced to an unprofitable point, as opposed to 5 years' work with deep chipping. Mechanical weakening of the trees is avoided.

On shallow-chipped slash, dry faces are only one-third as numerous as on deeply chipped slash pine. Injury from insect and fungus attacks on dry faces is correspondingly lessened.

In the width-of-face tests, two series of face widths were used—in one case one-fourth, one-half, and three-fourths of the circumference, and in the other case one-fourth, one-third and three-eighths.

Only 5 years' work is possible on the 75 percent faces, because the extreme width of face precludes the possibility of back facing. Three sets of faces, covering a minimum of 15 years, are possible on the narrow-faced group without intermediate resting periods, and one set of back faces on medium-faced (50 percent) trees. Total yields for wide, medium, and narrow faces may thus be estimated at 168.8, 262.5, and 372 barrels of turpentine per crop, respectively.

The second series of tests showed that the groups of faces that are one-third and three-eighths of circumference, yielded, respectively, 8 and 9 percent more than the narrow faces. However, three sets of faces may be cut in succession without interruption on the one-fourth circumference group, whereas some resting period may be required in the case of the wider faces before the trees can be worked with two sets of back faces.

A study of density of stand as it affects gum yields and the ability of the trees to be turpentined without damage indicated that more open-growing trees yield considerably more than trees in dense stands, and that there is less reduction in yield from year to year where the trees have plenty of space. A study of yield in relation to crown size indicated that more gum is obtained from the trees with larger crowns. Furthermore, on these large-crowned trees growing in the open there is less dry facing and faces heal more rapidly than in crowded stands.

A study of the effect of diameter size on naval stores yield brought out the fact that yields increase with size of tree and that trees smaller than 9 inches cannot be chipped with any assurance of obtaining a satisfactory profit unless the market prices are high or the trees considerably more vigorous than the average.

All chipping resulted in a reduction of diameter growth rate. This reduction increased with greater height of streak, greater depth of streak, and the use of two simultaneous faces as opposed to single faces.

Studies in 1920 by the U. S. Forest Service in Florida showed that growth of 1-face trees was reduced 27 percent and 2-face trees were reduced 40 percent.

Turpentining in fairly open longleaf stands apparently did not affect the ability of the trees to produce cones.

Dry facing is an important item in naval-stores management as it impairs the value of lumber and increases the likelihood of further degrade caused by insects and fungi. Dry facing is more serious in slash pine stands than in longleaf. It increases with density of stand and with greater depth of chipping and is normally more serious whenever any other destructive agencies have weakened the trees.

The principal insect associated with turpentining work is the turpentine borer *(Buprestis apricons)*. Damage by this borer may be kept under control by the use of conservative methods, such as shallow chipping and the cutting of narrow faces. Tacking tins and avoiding the use of ax cuts in the face also reduces the likelihood of damage from these borers.

The whole series of tests show that timber may be chipped for a much longer time than under present commercial methods, with a higher sustained yield and less damage to the trees, provided low streaks, shallow streaks, and narrow faces are used. Also, if work is confined to trees above 9 inches in diameter, well spaced, and with plenty of crown, gum yields may be considerably increased. The results from all the stands under observation at Starke indicate that annual mortality in second-growth turpentine stands may be kept down to 0.5 percent, provided conservative methods are employed.

The latest detailed experimental information on turpentining practices may be secured from Southern Forest Experiment Station, New Orleans, Louisiana.

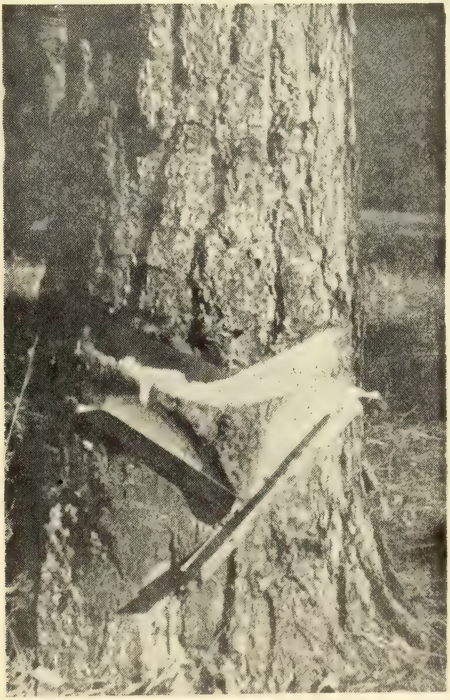


FIGURE 15—Tree with first streak and gutters attached.

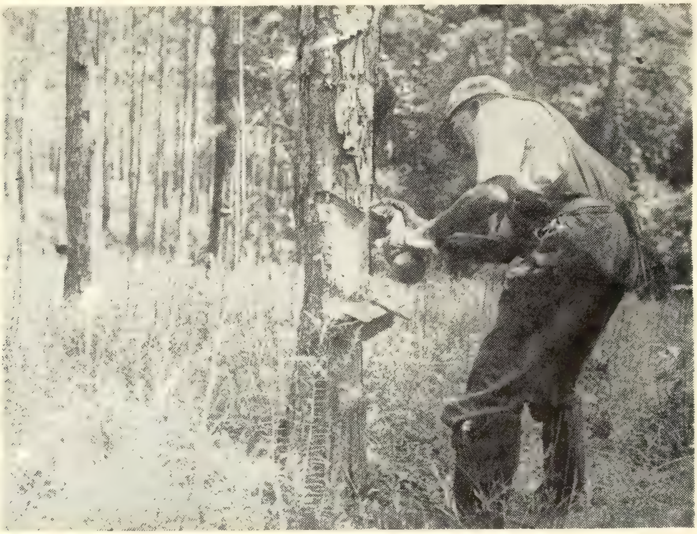


FIGURE 16—Streak is made on "Virgin" (face produced by first years' chipping) face with hack. The hack is used for streaking low faces. Note cover over the cup to keep out trash while streaking. This prevents lowering the grade of gum.

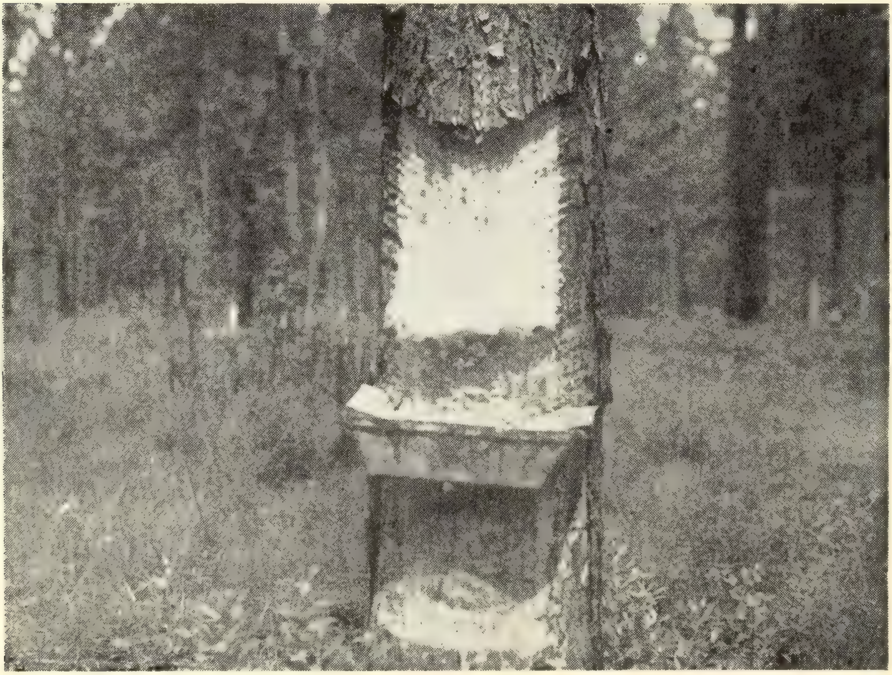


FIGURE 17—Tree in second year of production.

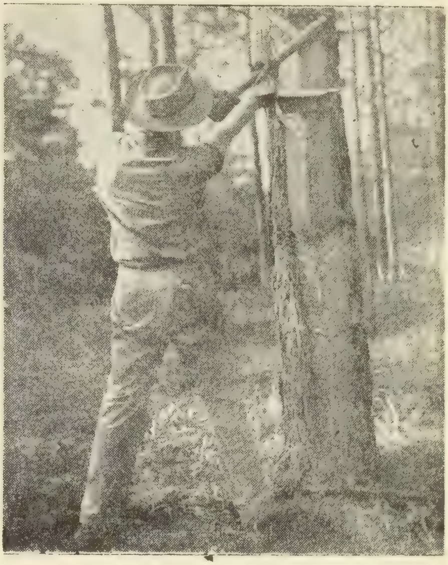


FIGURE 18.—Cutting streak with a puller, used for cutting streaks on high faces. Tree is beginning fifth year of production.

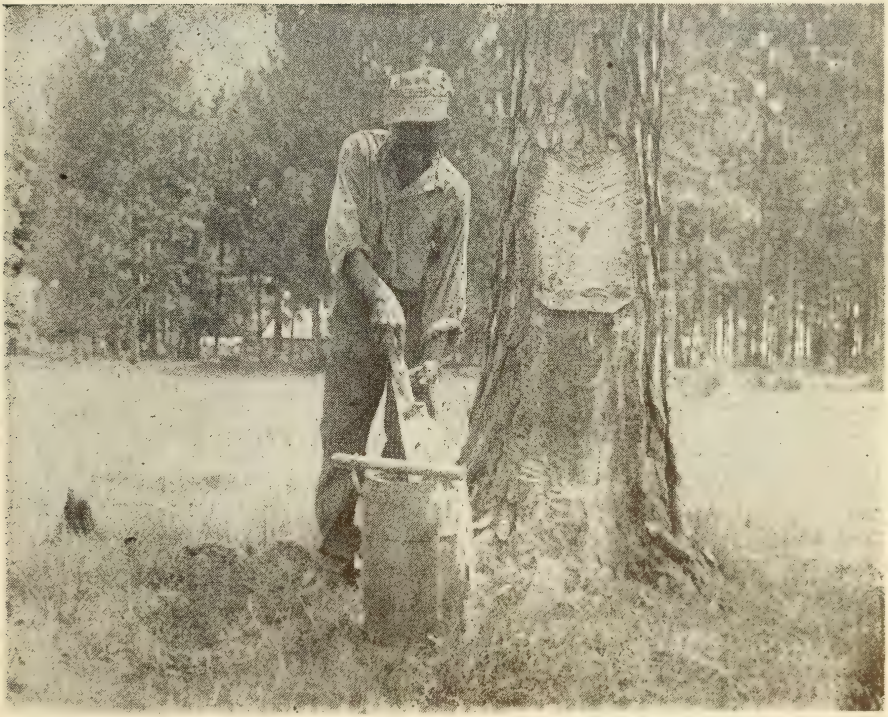


FIGURE 19—Crude gum is collected in dip bucket and put in dip barrels stationed at intervals over the forest.

FIGURE 20—The dip barrels containing crude gum are collected and delivered to turpentine stills for processing.

THE USE OF CHEMICAL STIMULANTS TO INCREASE GUM YIELDS

Research during recent years have proven that various chemical stimulants have increased gum yield from longleaf and slash pines. Many different stimulants have been used and all the acids used caused some stimulation of gum flow with certain concentrations. However, only two were consistently outstanding in promoting large increases in gum production, namely, sulphuric and hydrochloric acid. Of the two acids, sulphuric seems to be superior as a stimulant.

In addition to increased flow of gum it seems that the number of chippings can be reduced by the use of these stimulants. One of the biggest problems encountered in the use of these stimulants has been developing a satisfactory way of applying them to the streaks or faces. Research is still active in the various phases of this work and positive conclusions have not been made as to the best practices in applying stimulants which increases gum flow. Therefore detailed results of experiments to date are not included in this bulletin. For those who are interested in this subject it is suggested that for information on progress from time to time they may contact the Southern Forest Experiment Station, New Orleans, Louisiana.

It might be added that no tree that has been in the experiment thus far has been killed by chemical treatments, and most important, trees that are now in their fourth year of treatment are still producing more gum than those not treated.

Another important fact is that from results thus far neither the acid or caustic soda treatment has had any effect on resin grades.

TURPENTINE STILLS

Plants or stills in Mississippi that produce gum turpentine and resin from crude gum are located at Lucedale, State Line, Long Beach, Ocean Springs, Vancleave, Wiggins, Battle, Bucatunna, Clara, and Waynesboro.

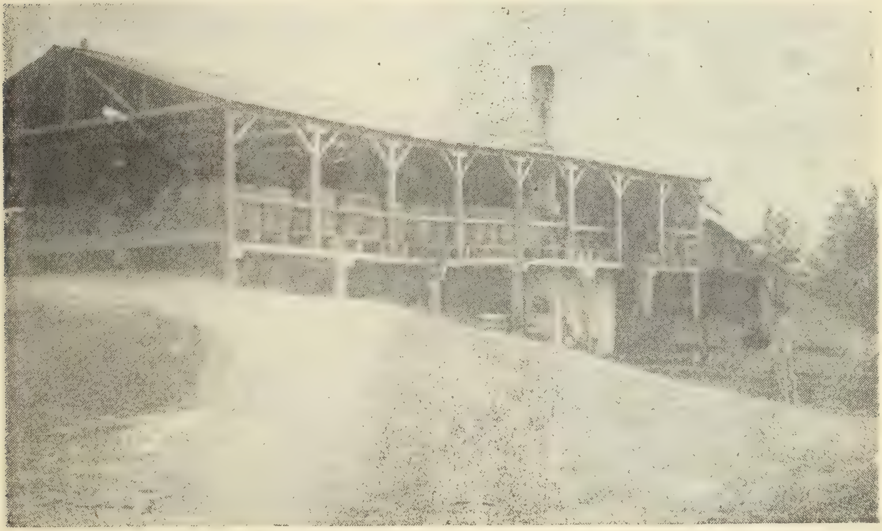


FIGURE 21—Turpentine still, Wiggins, Mississippi, provides market for gum farmers in Stone and adjoining counties.

References: (1) United States Department of Agriculture Farmers' Bulletin No. 1256, "Slash Pine," pp. 1, 2, 3, 4, 8, 9, and 11. Washington, D. C., September, 1944. (2) United States Department of Agriculture Technical Bulletin No. 398, "Experiments in Naval Stores Practice," pp. 48, 49, and 50. Washington, D. C., April, 1932. (3) Southern Forest Experiment Station, Occasional Paper No. 106, "The Use of Chemical Stimulants to Increase Gum Yields in Slash and Longleaf Pines," pp. 2, 3, 4, 7, 8, 10, 11, 15, 16, 17, 23, 26, 28, 29, and 30. New Orleans, Louisiana September 1, 1944. (4) Chemurgic Reprint Series No. 29, "Gum Naval Stores Industry" by Carl E. Ostrom and Keith W. Dorman, Southern Forest Experiment Station, New Orleans, Louisiana. Reprint from the Chemurgic Digest, September, 1945.

PART VI

PRESERVATIVE TREATMENTS OF FARM TIMBER

The quality of wood used on the farms of the country and exposed to decay is very great. The total is difficult to estimate, but it undoubtedly amounts to several billion board feet annually. This wood is used in various forms, such as fence posts, buildings, bridges, culverts, shingles, telephone poles, silos, vine stakes, and small buildings. For such uses durability is usually of great importance.

Some woods resist decay better than others. A post of one kind of wood may last 10 years or more, while one of another kind may last only two years under the same conditions. There is also a great difference in the durability of wood of the same species under different conditions. When the posts are actually submerged in water or a very dry situation they will last longer than in a situation where the ground is simply damp or alternately wet and dry. It will last better in a compact clay soil than in a loose sandy soil. A warm, moist climate is more favorable to decay than a dry one, or one that has long, cold winters.

Durable woods are continually growing scarcer and higher priced in most localities and less durable woods must be used in their stead. Many of the non-durable woods in their natural condition will last only two or three years in situations favorable to decay. It will readily be seen, therefore, that any reasonably cheap method of increasing their life will save money for the user.

For a number of years experiments on the preservative treatment of fence posts, poles, and other forms of timber exposed to decay, have been made by federal and state forest services in cooperation with agricultural experiment stations, farmers, and various companies. They have proved conclusively that when a suitable preservative treatment is given posts or poles that would ordinarily rot quickly they can be made to last 12 to 25 years and that similar resistance to decay can be obtained with other forms of timber.

REQUIREMENTS OF PRESERVATIVES

There are six important requirements for a preservative for general use: (1) it should be safe to use, (2) should be reasonably cheap, (3) should penetrate wood readily, (4) should not be corrosive to metal, (5) should not evaporate or wash out of the wood easily, and (6) should be poisonous to fungi. For special purposes there are, of course, additional requirements.

Details are given below for preservative treatment of fence posts with Pentachlorophenol, which, according to the Mississippi Agricultural Experiment Station, shows promise of being a practical, efficient method of preserving farm timbers.

If details are desired on various other methods of preservative treatments, they may be secured by writing the Mississippi Agricultural Experiment Station for Bulletin No. 439, "Fence Posts: Production and Treating Costs", by W. C. Hopkins, November, 1946.

PENTACHLOROPHENOL COLD SOAKING TREATMENT FOR FENCE POSTS[1]

Recent experiments at State College have shown that fence posts can be satisfactorily treated by an inexpensive and simple method which requires little equipment and which promises a service life of 12 to 20 years per post. The following sets forth in detail the procedure to be followed in using the pentachlorophenol cold soaking treatment on fence posts.

EQUIPMENT NEEDED

The only equipment required is a watertight tank six inches longer than the longest post to be treated. The tank may be any convenient depth and width. A rectangular tank about 2' x 2' x 8' is suggested.

The tank may be built of 2" x 12" tongue-and-grove lumber caulked with cotton, red lead or some other caulking material. One hundred twelve board feet of 2" x 12" lumber is required for a tank 2' x 2' x 8'. Needed are six pieces eight feet long and four pieces two feet long. Such a tank will hold 12 to 20 posts of 4" to 6" in diameter and will require about 150 gallons of preservative to start with. If posts longer than 7½ feet are to be treated, the tank must be accordingly longer.

PRESERVATIVE

Pentachlorophenol concentrated solution, diluted with No. 2 fuel oil in the proportions recommended by the manufacturer may be obtained from:

Chapman Chemical Company Pere Marquette Building New Orleans, Louisiana or Memphis 9, Tennessee	Permatox Concentrate which is used one gallon of concentrate to ten gallons of fuel oil.
Wood Treating Chemicals Company St. Louis, Missouri	Timbertox concentrate as well as permatox should be mixed with fuel oil so that a 5 percent solution is obtained. Follow manufacturer's instructions on container to obtain this mixture.
Monsanto Chemicals Company St. Louis, Missouri	"Permassan 60". Ready to use.

The concentrates cost about $2.00 per gallon, and fuel oil costs about 10 cents per gallon. The preservative solution recommended —1 gallon of concentrate to 10 gallons of fuel oil—would, therefore, cost about 27 cents, or 7 cents per quart of solution. Approximate cost of solution per treated post may be figured from table 11 below, showing number of quarts of preservative solution required for posts of different sizes. Examples: posts 6-7 feet long, 3-4 inches diameter at top, will require 1 quart of solution, costing 7 cents each; posts 8-9 feet long, 5-6 inches diameter, will require 3 quarts of solution, costing 21 cents each.

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[1] Mississippi Agricultural Experiment Station Information Sheet No. 392, "Pentachlorophenol Cold Soaking Treatment for Fence Posts" by Monty Payne and W. C. Hopkins, State College, Mississippi, June, 1947.

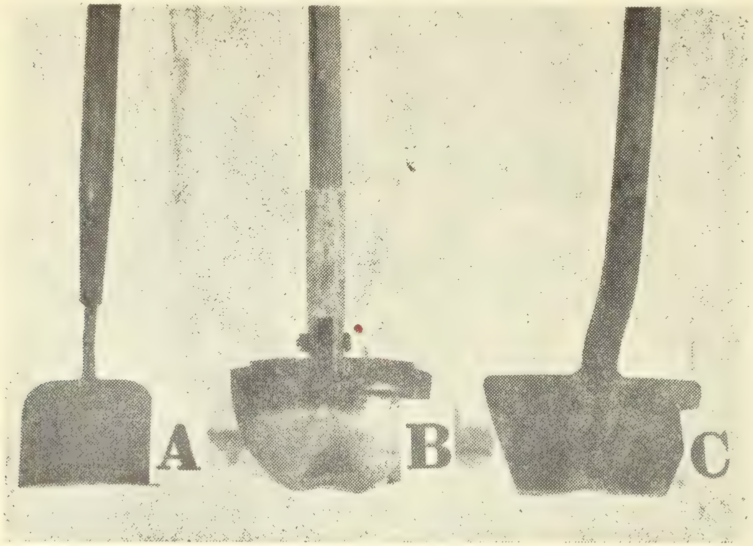


FIGURE 22—Post peeling tools: a. Hoe, b. Bottom half of shovel, c. Top half of shovel.

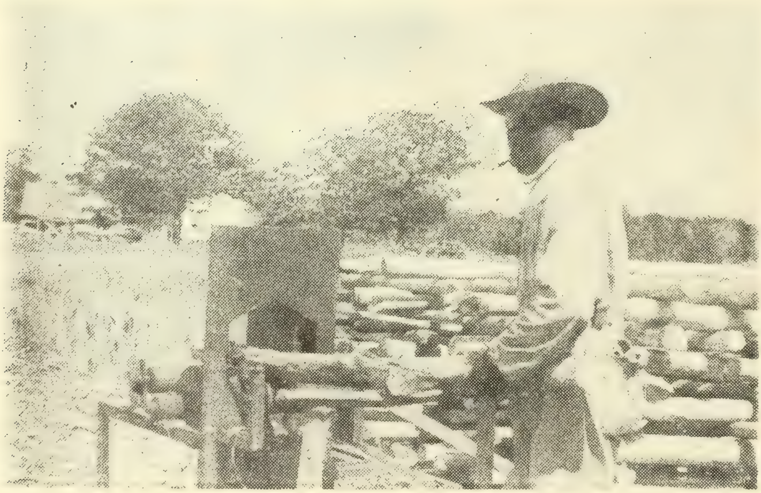


FIGURE 23—A mechanical chain peeler operated by one or two men peels posts clean and in from 45 seconds to 2 minutes per post depending on the species, season of year and length of time between cutting posts and peeling posts.

Table 11. Number of quarts of preservative solution required for posts of different sizes

	Diameter at small end of post					
	2-3 inches	3-4 inches	5-6 inches	7-8 inches	9 inches	10 inches
Post length	Quarts of preservative required per post					
6-7 feet	1	1	2	4	6	8
8-9 feet	2	2	3	5	8	9
10 feet	2	2	3	6	9	11

Approximate time required to get these absorptions:

Pine	3 hours	Elm	20 hours
Red Oak	6 hours	Gum	4 hours
Post Oak	96 hours		

TREATMENT

Posts must be well peeled (all bark, both outer and inner removed) and dried for at least 60 days in the summer and 120 days in the winter. Peeling is most easily done in the spring. Figure 22 shows simple tools for peeling posts. Figure 23 shows a mechanical peeling machine.

Assort posts for treating, placing those of the same length, diameter, and species together. Figure 24 shows a good method of stacking posts.

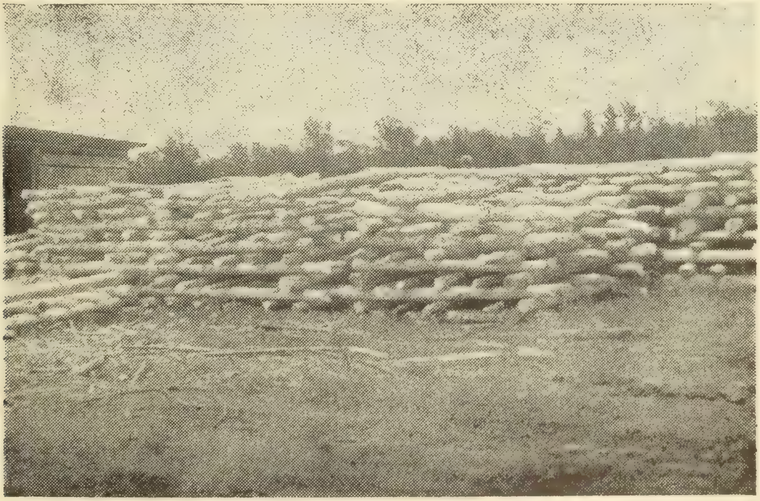


FIGURE 24—Fence posts peeled and stacked for seasoning period of 60 days in summer, 120 days in winter. They will then be ready for preservative treatments. Posts peeled by chain barker at Newton Branch Experiment Station of Mississippi Agricultural Experiment Station.

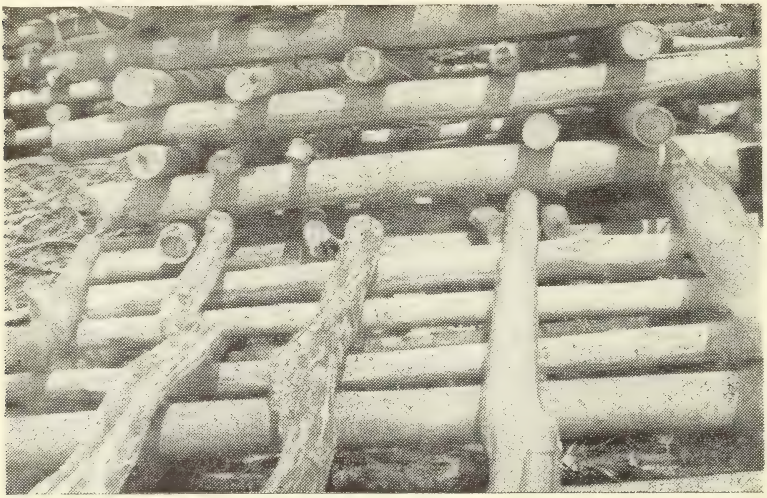


FIGURE 25—Machine peeled (chain barker) does better job of removing inner bark than hand peeled posts as shown in picture. The three posts on top, foreground were hand peeled, the rest machine peeled. Machine peels pine posts at rate of 50-75 per hour, oak, ironwood, and sweetgum 20-35 per hour. Posts must be freshly cut in March-April and May to get best results from peeling. Work done at Newton Branch Station, Mississippi Agricultural Experiment Station.

Place posts in tank leaving a minimum of 8 inches from the top of tank down to top layer of posts. Barely cover posts with preservative. Then determine number of quarts to be absorbed by each batch of posts by referring to table 11. For example, 20 posts 3 to 4 inches in diameter, 7 feet long would require 20 quarts of preservative to treat properly. Thus, you would add 20 quarts of preservative to that already in the tank (which already barely covers the posts). Weight posts down to prevent floating and leave posts in tank until preservative drops back to the level where posts began to show above fluid. Remove posts from tank, stack to dry, then add a new batch of posts and repeat process.

Keep livestock away from treating tank.

Reference: United States Department of Agriculture Farmers' Bulletin No. 744, "The Preservative Treatment of Farm Timbers," Washington, D. C.

Reference: Mississippi Agricultural Experiment Station Information Sheet No. 392, "Pentachlorophenol Cold Soaking Treatment for Fence Posts" by Monty Payne and W. C. Hopkins, State College, Mississippi, June, 1947.

PART VII

MARKETING AND UTILIZATION OF FARM TIMBERS

MARKETS

An attempt is made here to show the various classes of products that are manufactured in Mississippi from forests; also the names and addresses of the manufacturing plants. This means that such plants afford available market for various classes of timber. However, as shown in discussions below, there are in many cases local dealers who buy farm timber and/or products that are in turn sold to the manufacturing plants either in Mississippi or elsewhere.

SAWLOGS

There is a market for sawlogs or lumber in every county and even in most communities in Mississippi. In most cases there is a local person who owns a portable or other type sawmill, who will buy the farmer's timber. Farm timber is sold too often by tracts for a given sum of money. In some cases, however, it is sold subject to a log or lumber scale, or the standing timber is estimated, either of which is a better method than selling for a lump-sum without estimating or measuring the timber to be sold.

PULPWOOD

Farmers in most communities of Mississippi can market pulpwood either to local buyers or receivers or by delivering the timber to plants. The Masonite Plant, Laurel; Flintkote Plant, Meridian; Gypsum Plant, Greenville; and International Paper Mill of Pascagoula, are all located within the State. Several out-of-state mills have local representatives at various railroad points, almost throughout the State, who will buy either standing pulpwood timber, or buy it cut and stacked at the farm, or delivered to the railroad.

Having available markets for pulpwood is very important. Where thinning of small trees is necessary, the timber can be sold for pulpwood, thereby giving farmers wages for their time in doing a necessary job and, also, a market for timber that might otherwise be wasted.

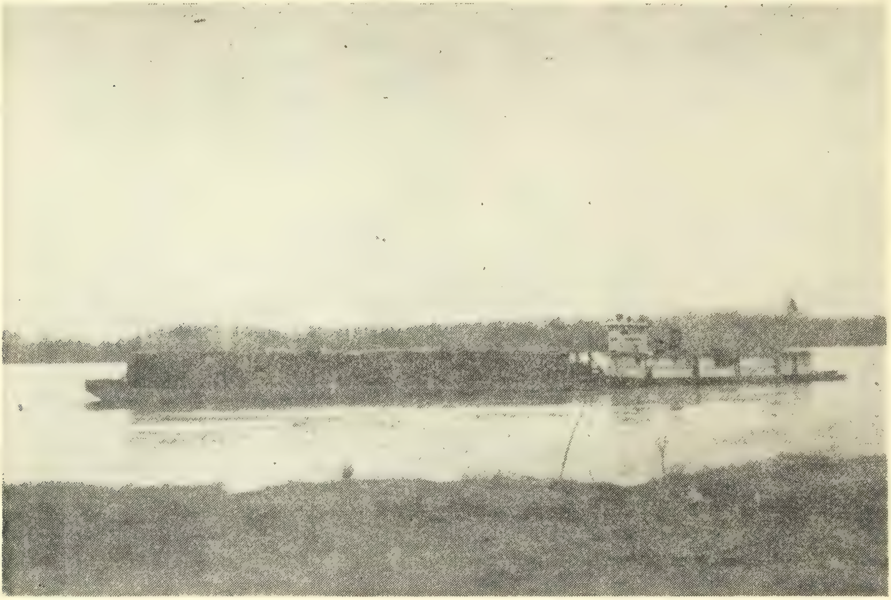
PULP AND BOARD MILLS

Below is a list of plants in Mississippi and neighboring states that provide markets for pulpwood:

Paper Mills

Name of firm (handle unpeeled wood)	Addresses
Gaylord Container Corporation	Bogalusa, Louisiana
Brown Paper Company	Monroe, Louisiana
Southern Craft Division of International Paper Company	Bastrop and Springfield, Louisiana, Mobile, Ala., Pascagoula, Miss.
Gulfstates Paper Company	Tuscaloosa, Alabama
Hollingsworth & Whitney	Mobile, Alabama
National Gypsum	Mobile, Alabama
Board Mills	
Flintkote Company	Meridian, Mississippi
Masonite Corporation	Laurel, Mississippi
United States Gypsum Company	Greenville, Mississippi
Meade Corporation	Kingsport, Tennessee

The last three companies use only peeled wood and they also use hardwoods with the exception of Oak, hickory, and dogwood.



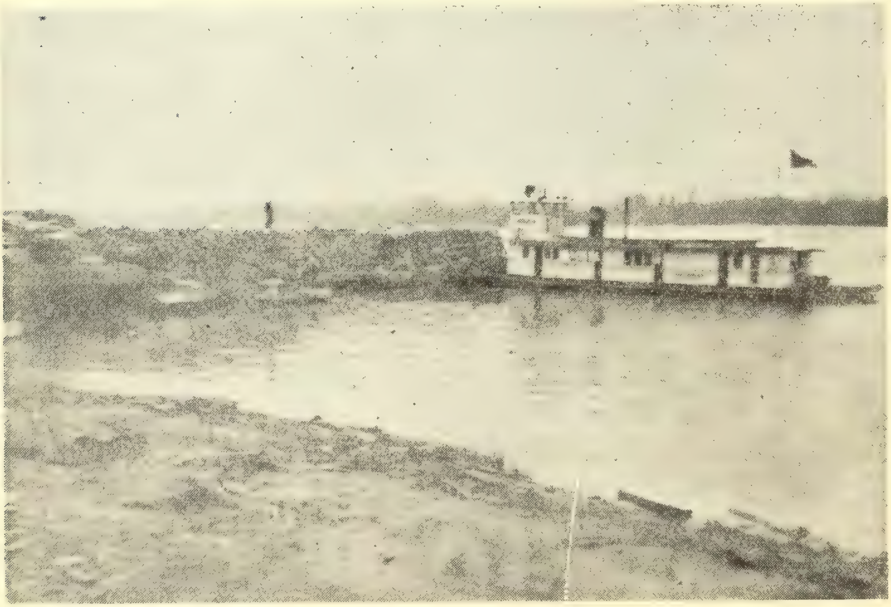


FIGURE 26—Two views of cottonwood and willow pulpwood being transported by water to board plant at Greenville, Mississippi.

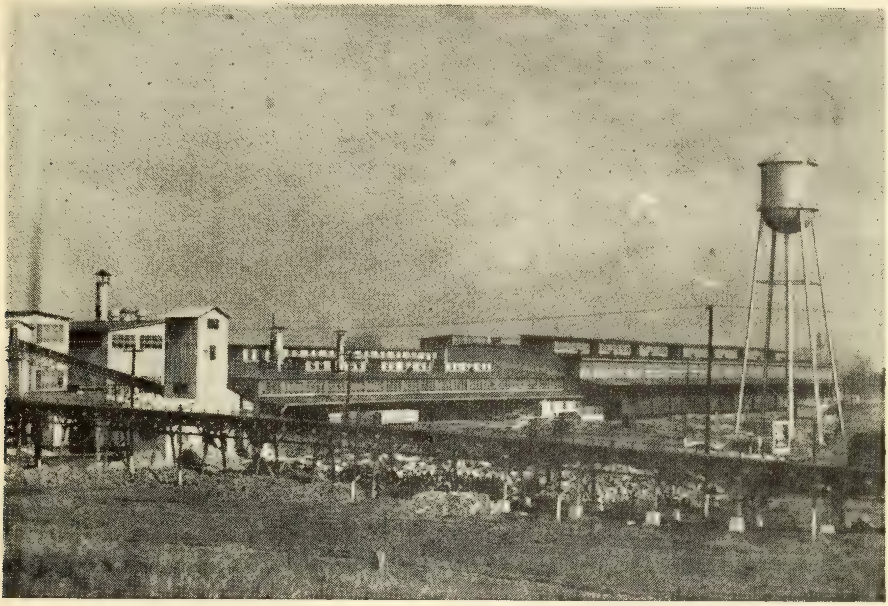


FIGURE 26a—Board plant at Greenville, Mississippi. Plant employs about 600 people.

POLES, PILING, AND CROSSTIES

Marketing poles and piling is very important since the price of these products is much higher as a rule, when based on the number of board feet, then pulpwood or sawlogs. This is true because of the scarcity of timber that is of sufficient size and length and straight enough to make desirable poles.

Unlike sawlogs and pulpwood, the markets for poles and piling in Mississippi are not so plentiful. However, poles can be shipped by rail or delivered by truck to various points in the State. They must be creosoted, thus, they are usually delivered to creosoting plants regardless of who might buy them.

In many places very few or no poles are sold and thus there are no local buyers. In such cases it may be necessary to contact some of the firms that handle these products.

Below is a list of firms that handle poles, piling, and/or crossties:

Name of firms	Addresses
Ayre-Lord Tie Company	Grenada, Mississippi
Gulf States Creosoting Company	Jackson, Meridian, and Hattiesburg, Mississippi
Gulfport Creosoting Company	Gulfport, Mississippi
West Pascagoula Creosoting Works	Pascagoula, Mississippi
T. G. Moss Tie Company, Agency	Columbus, Mississippi
Enoch Lumber Company Gulfwood Preserving Corp.	Fernwood, Mississippi
American Creosoting Works	Louisville, Mississippi

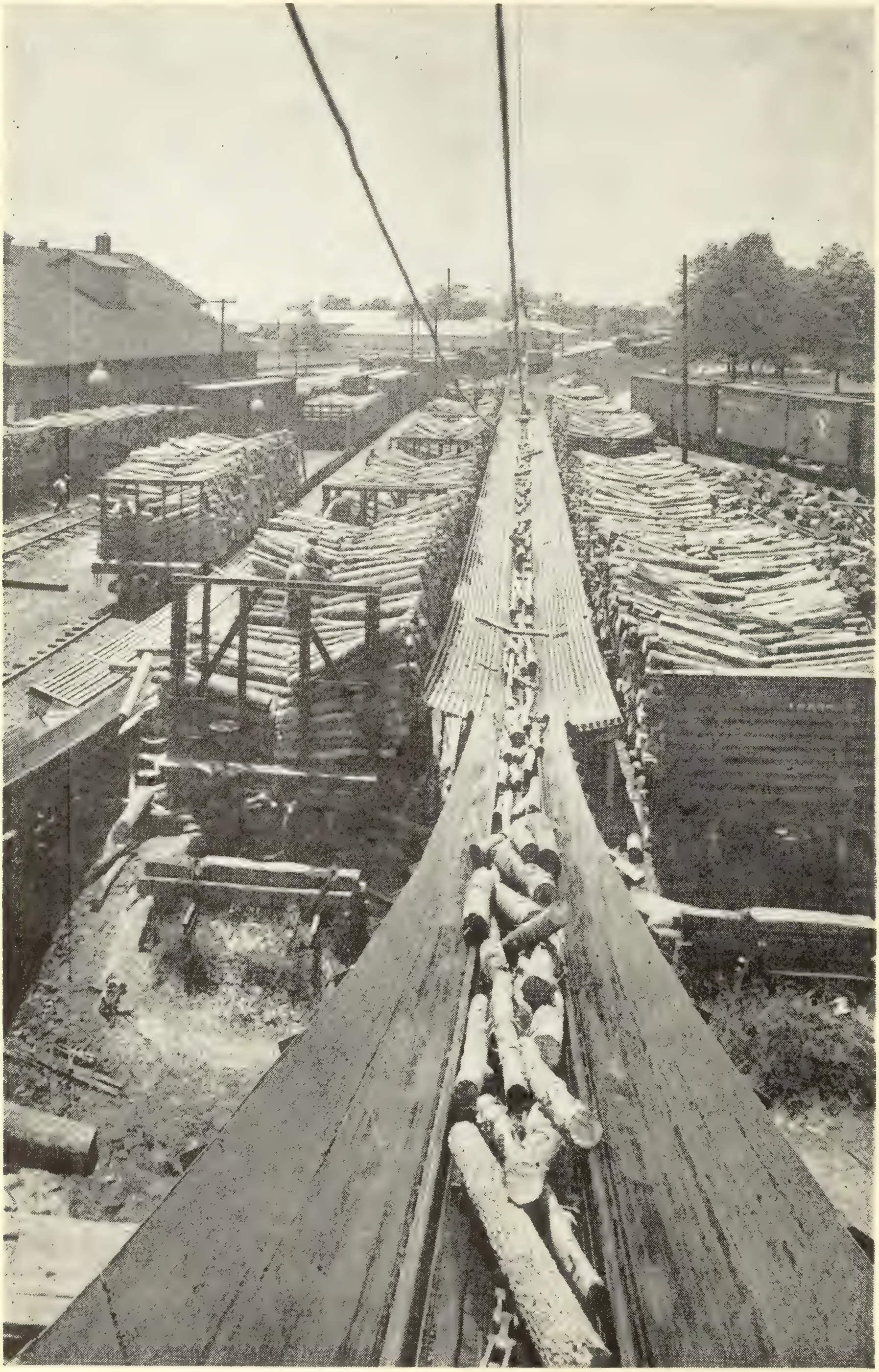


FIGURE 27—Largest single industry in Mississippi. This board plant, located at Laurel, Mississippi, provides a market for all types of pulpwood except oak and hickory and employs over 2,000 people.

There are many local buyers or dealers of crossties in the State and they are probably too numerous in number to list at this point. However, practically all crossties are bought directly for or sold to creosoting companies; therefore, if there is not a local market for crossties, farmers might contact the nearest creosote company for information on prices, delivery points and names of buyers.

SPECIALTY PRODUCTS

There are quite a few special products made from forest timbers in Mississippi, namely, boxes and crates, building materials, caskets, shuttle blocks, farm implements, furniture, implement handles, sash doors, staves, trailers and bodies, veneer board, wagons, prefabricated houses, and shipbuilding repairs. The towns where some or most of these various products are made are listed below:

Chemical naval stores and by-products from pine stumps. Plants are located in Laurel, Hattiesburg, Gulfport, Columbia, and Picayune.

Boxes and crates. These are made at Natchez, Port Gibson, Grenada, Biloxi, Jackson, Lumberton, Meridian, Fernwood, and Greenville.

Caskets are made at West Point, Lucedale, Jackson, Marks, Yazoo City.

Shuttle blocks are made of dogwood at Port Gibson, Oxford, Brookhaven.

Farm implements are made at Houston, Jackson, Prentiss, Laurel, Greenwood, Pontotoc, Randolph, Baldwyn, and Booneville.

Furniture is made at Corinth, Vardaman, Hattiesburg, Laurel, Meridian, Thomastown, Brookhaven, Columbus, Canton, Poplarville, McComb, Pontotoc, Booneville, Iuka, Louisville, and Noxapater.

Implement handles are made at Potts Camp, Pyland, Van Fleet, Meridian, Jackson, and Louisville.

Prefabricated houses are made at Jackson and Laurel.

Sash and doors are made at Smithdale, Hattiesburg, Biloxi, Jackson, Meridian, Yazoo City, and Prentiss.

Ship building repairs are done in Biloxi, Gulfport, Ocean Springs, and Pascagoula.

Staves are made at Natchez, Kosciusko, Pachuta, Clarksdale, Friars Point, Sherard, Grenada, Bolton, Jackson, West, Bay Springs, Oxford, Meridian, Greenwood, Columbus, Way, Amory, Philadelphia, Batesville, Brandon, Lake, Morton, Vicksburg, Greenville, and Water Valley.

Trailers and bodies are constructed at Corinth, Okolona, Jackson, Oxford, Greenwood, Philadelphia, Booneville, Vicksburg, and Eupora.

Veneer boards ar made at Natchez, Port Gibson, Leaf, Leakesville, Pascagoula, Laurel, Meridian, Orna, Columbus, Columbia, Picayune, Beaumont, Fernwood, Greenville, and Waynesboro.

Wagons are made at Durant, Lexington, Laurel, Oxford, Meridian, and Louisville.

In addition, there are wood working shops in West Point, Meridian, Lucedale, Canton, Newton, Ecru, Pontotoc, and Mendenhall, in which various items, too numerous to list, are manufactured. However, these shops provide a market for a limited amount of various kinds of timber, principally hardwoods.

There are quite a few plants in the State that produce gum, turpentine, and resin from crude gum. However, naval stores are discussed in another chapter in this bulletin and these plants are listed in that section.

Reference: Mississippi Board of Development Report, "Index of Manufacturers in Mississippi," p. 10 to 52, Jackson, Mississippi. January, 1943.

SELLING TIMBER ON A GRADE BASIS, ALSO DELIVERED PRICES vs. FARM PRICES

In the table below is shown comparisons of estimated returns from saw-timber, pulpwood, crossties and piling, on the stump and delivered to the railhead. This table might be helpful to the farmer in deciding what type of product to sell and whether or not to sell on the stump or deliver to local markets.

The prices used in making these estimates were estimated average prices received in 1945 by farmers in Mississippi. The volumes in board feet were calculated from the Scribner Decimal C. Rule which is about equal to green lumber tally for a portable sawmill.

The prices used for products delivered to the railhead are for processed products in the case of saw-timber and crossties and are probably not comparable to pulpwood and piling.

Table 12. Comparison of returns from a 12-inch tree d.b.h., with three 16-foot logs containing 110 board feet, Scribner Decimal C. Rule, used for different type products, also on a per thousand board feet basis. 1/

	Value of different products			
Units	**Saw timber**	**Pulpwood**	**Crossties**	**Piling**
1. Stumpage				
A. Per M. b. f.	$10.00	$3.00	$6.06	$13.09
B. Per tree	1.10	.36	.67	1.44
2. Delivered to R. R.				
A. Per M. b. f.	35.00 2/	15.20 3/	32.12 2/	43.64 3/
B. Per tree	3.85 2/	1.86 3/	3.43 2/	4.80 3/

1/ Estimates and calculations made by the Forestry Department, Agricultural Experiment Station, State College, Mississippi.

2/ Processed products.

3/ Peeled.

From the above table and figures it can be readily seen that the farmer's income from timber depends to a large degree on the type of product sold, when it is sold, and whether or not it is processed. Table 16 shows that a 48-foot tree, 12 inches d.b.h., containing 110 board feet could be sold for $0.36 or $1.44 at the stump using the two price extremes or the high and low possibles. Delivered to the railhead, the tree might be sold for $1.86 or as much as $4.80. It is evident from these figures that all pine trees with enough body length and that are large and straight enough should be sold for poles or piling. If not, they should be sold as sawlogs or made into lumber, if they are 10 inches or more in diameter and not culls. However, if a tree is 10 inches in diameter or larger, it may be made into crossties and bring the farmer more money than if sold for pulpwood. If a farmer has plenty of labor at certain times of the year so he may manufacture crossties by hand, when he does not have access to a sawmill, he can get the additional price shown above. Whether or not a farmer cuts his itmber for piling, poles, lumber, or crossties should depend upon the grade of the timber. In case it is used for lumber or crossties, whether it is manufactured and/or delivered to the railhead should be determined by the labor and equipment available.

Information below, including tables, might be helpful to farmers in deciding what use should be made of the various kinds and sizes of trees on his farm.

PILING AND POLES

Table 13 shows the value of various sizes and length of pine trees, for piling. The specifications for piling are very exacting because to drive them into the ground, top down, they must be sound and absolutely straight; also they must have an even and gradual taper from butt to top.

The prices used in tables 13, and 14 are as of December, 1942, f.o.b. cars.

Table 13. Value of piling of various sizes and lengths, f.o.b. car and at the stump.

Minimum diameter in inches at		Length in feet	F.O.B. car prices		Stumpage value @ 50% of f.o.b. car prices
Stump	Top		Per lineal feet	Total price per piling f.o.b. cars	
14	6	70	$0.23	$16.10	$8.05
14	6	60	0.18	10.80	5.40
13½	7	55	0.15	8.25	4.12
13½	7	50	0.14	7.00	3.50
13	8	45	0.12	5.40	2.70
13	8	40	0.12	4.80	2.40
12½	8	35	0.10	3.50	1.75
12½	8	30	0.10	3.00	1.50

Reference: "Slash and Longleaf Pine Growers' Handbook" by M. E. Henegar, Industrial Extension Forester, The Newton Company, Incorporated, Lake City, Florida, p. 16.

(Note: Tables 14, 15, 16, 17, 18 and 19 were taken from pp. 17, 20, 22, 24 and 25 of the same reference.)

Poles are graded into several classes and the specifications are not as exacting as they are for piling. Because the poles are set in the ground with the small end up, the taper does not need to be exact and gradual and there may be small bulges or slight reverse curves so long as the pole has a straight line from end to end and is sound. Many pines that will not meet the piling specifications will manufacture into poles of good grade and high market value, as shown in the following pole table:

Table 14. Prices of poles by classes, sizes, and lengths f.o.b. cars and stumpage.

Class of pole	Minimum diameter in inches at		Length in feet	F.O.B. Car prices		Stumpage value at 50% of f.o.b. car prices
	Stump	Top		Per lineal feet in cents	Total price per pole	
2	17-1/4	8-1/4	75	30-2/3	$23.00	$11.50
4	15-1/2	7	75	17-1/3	13.00	6.50
2	17	8	70	25-5/7	18.00	9.00
3	16	7-2/3	70	18-6/7	13.20	6.60
4	15-3/4	7	70	15-3/7	10.80	5.40
2	16-1/2	8-1/4	65	23-1/13	15.00	7.50
3	15-1/2	7-2/3	65	18-6/13	12.00	6.00
4	14-1/2	7	65	14-10/13	9.60	4.80
2	16	8-1/2	60	20	12.00	6.00
3	15	7-2/3	60	16-2/3	10.00	5.00
4	14	7	60	11-2/3	7.00	3.50
2	15-1/2	8-1/4	55	15-5/11	8.50	4.25
3	14-1/2	7-2/3	55	12-8/11	7.00	3.50
4	13-1/2	7	55	10	5.50	2.75
2	15	8-1/4	50	14-2/3	7.20	3.60
3	14	7-2/3	50	12	6.00	3.00
4	12-2/5	7	50	9-1/2	4.75	2.37
2	14-1/2	8-1/4	45	11-2/3	5.25	2.62
3	13-1/2	7-2/3	45	10-5/9	4.75	2.37
2	13-9/10	8-1/4	40	9-3/8	3.75	1.87
3	13	7-2/3	40	7-1/2	3.00	1.50
4	12	7	40	6-7/8	2.75	1.37
2	13	8-1/4	35	8-4/7	3.00	1.50
3	12-2/5	7-2/3	35	7-1/7	2.50	1.25
4	11-1/2	7	35	6	2.10	1.05
5	10-3/4	6-1/3	35	5	1.75	.87
6	10	5-3/4	35	3-3/7	1.20	.60
4	10-3/4	7	30	4	1.20	.60
5	10-1/4	6-1/3	30	3-1/2	1.05	.52

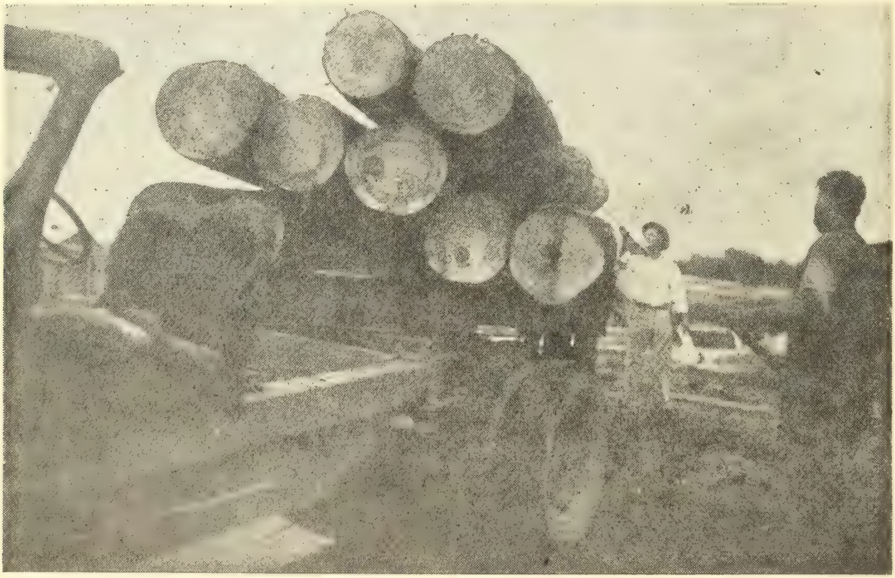


FIGURE 28—Farmer has delivered logs to railroad siding and is having them scaled to determine the number of board feet in the load.

LUMBER

After the piling and poles have been selected from the timber stand, lumber in point of value is next in importance. The most commonly used log rules are the International Scribner Decimal C. and the Doyle rules. The International rule will give the timber grower the greatest volume of board feet of lumber from logs of the prevailing second growth timber.

If it is desirable to sell standing timber for lumber, a fairly accurate estimate can be made by use of table 15 which is an International log rule table.

To compute the stumpage of standing trees, using a price of $10.00 per thousand board feet, multiply the number of board feet in a tree by one cent.

Table 15. International log rule for estimating standing timber (pine).

DBH outside bark in inches	Board feet contents of trees with from 1 to 5, 16-foot logs per tree				
	1	2	3	4	5
7	18	27	42		-----
8	20	34	52		----
9	23	39	63	88	--
10	25	44	76	106	139
11	----	51	88	125	166
12	----	57	101	146	192
13	----	62	115	170	221
14	----	70	129	187	250
15	----	76	143	211	282
16	----	83	160	234	314
17	----	----	177	261	348
18	----	----	193	287	384
19	----	----	212	315	422
20	----	----	231	345	463

CROSSTIES

After the piling poles and lumber trees have been selected the next wood product in point of value is crossties. Most standard gauge railroads use a standard length tie of 8½-foot and 7½-foot length and one company uses a 9-foot length tie as its standard. The most common dimension of standard ties are 7" x 9", 7" x 8", 6" x 8", and 6" x 7", and more recently some roads are using ties that are just slabbed on two sides to a standard of 7 inches and 6 inches thick.

The minimum diameters at small end inside bark of logs 8½ feet long that will hew out ties of the standard dimensions are as follows: For 7" x 9" ties, minimum diameter of 11½ inches; for 7" x 8" ties, minimum diameter of 10½ inches; for 6" x 8" ties, minimum diameter of 10 inches; for 6" x 7" ties, minimum diameter of 9 inches.

The approximate number of ties of the varying dimensions that may be cut from standing trees may be arrived at by estimating the diameter of the tree inside the bark at 8½ feet from the stump and continue up the tree estimating the diameter at points in multiples of 8½ feet until the diameter of the tree is reduced to minimum of 9 inches.

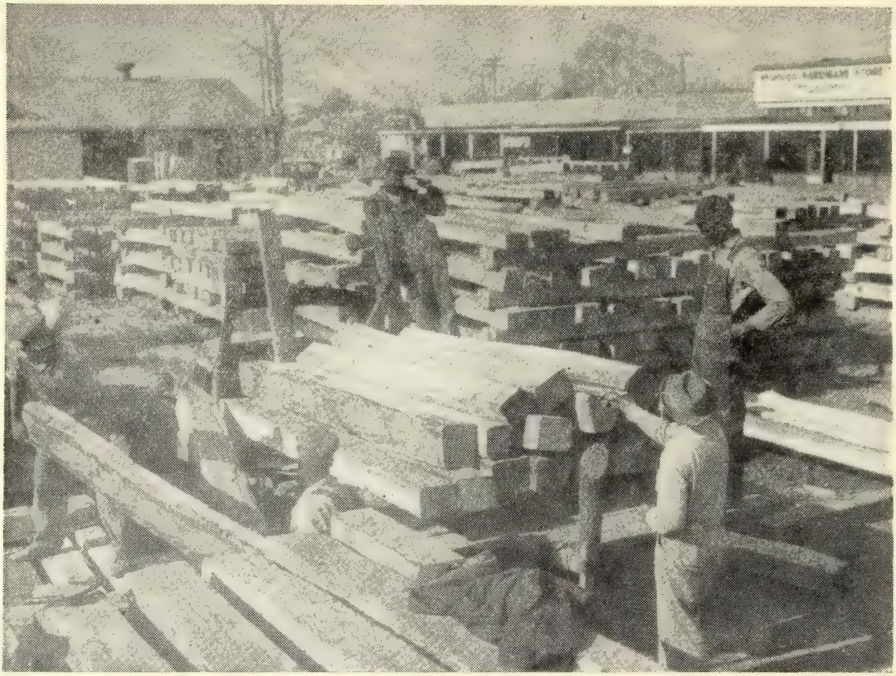


FIGURE 29—Farmers in Wayne County having crossties inspected by buyer at railroad siding. Farmers today are receiving $0.85 to $1.30 for crossties delivered.

In the latter part of 1942 and first part of 1943, tie prices for 8½-foot standard dimensions were approximately: for 7" x 9", $1.20; 7" x 8", $1.00; 6" x 8", $0.80; 6" x 7", $0.70 f.ob. cars. The stumpage value usually runs about 25 percent of the f.o.b. car prices.

The following table will illustrate the various dimensions of ties that may be hewn from 8½-foot length logs of minimum diameters at small end inside bark and the approximate stumpage value at 25 percent of the f.o.b. car prices.

Table 16. Diameter of logs, dimension of ties and value per tie on the stump and F.O.B. cars

Minimum diameter of logs and dimensions of ties in inches		Value per tie	
Diameters	**Dimensions of ties**	**F.O.B. cars**	**Stumpage at 25 percent of f.o.b. car price**
11-1/2"	7" x 9" x 8-1/2'	$1.20	$0.30
10-1/2"	7" x 8" x 8-1/2'	1.00	0.25
10"	6" x 8" x 8-1/2'	0.80	0.20
9"	6" x 7" x 8-1/2'	0.70	0.17-1/2

PULPWOOD

After the piling, poles, lumber and ties have been selected, the tops or otherwise waste portion of the pines have a salvage value and should be sold as pulpwood or fuelwood. Also thinnings of small lumber from thick stands can be used for pulpwood.

Pulpwood is usually sold by the unit of 160 cubic feet and when the sticks are 5 feet long and put into stacks 4 feet high and 8 feet long (5' x 4' x 8') it makes a unit. Pulp mills require the sticks to be cut usually from 3 inches to 5 inches longer than 5 feet (63 inches to 65 inches) which runs well over the 160 cubic feet per unit but the price usually remains the unit price.

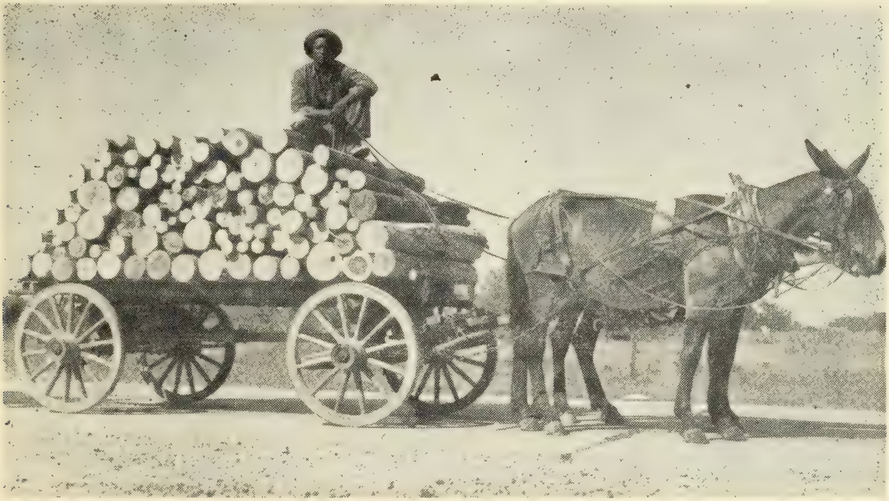


FIGURE 30—Homer Taylor, tenant on farm of C. B. Carlee, Alcorn County. Using his own wagon and team, he has cut, peeled, and is shown hauling pulpwood to the railroad car. The farmer received from $9.99 to $14.00 per unit for this type of wood loaded on the railroad car.

The following pulpwood table will serve as a guide for computing the approximate number of units that may be cut from standing pines of various diameters and heights.

Table 17. Number of trees, of various sizes and heights, required to make a unit of pulpwood

DBH in inches	Approximate number of trees of various d.b.h.'s outside bark from 30' to 100' in total height required to make a unit of pulpwood							
	30'	40'	50'	60'	70'	80'	90'	100'
14	....	....	5	4	4	3	3	2
13	....	....	6	5	4	3	3	3
12	....	10	7	6	5	4	3	3
11	....	11	8	7	5	5	4	—
10	....	14	10	8	7	5	5	—
9	....	18	12	10	8	7	5	—
8	30	21	15	12	9	8	—	—
7	39	26	20	15	12	10	—	—
6	50	35	26	20	16	—	—	—
5	69	46	34	27	—	—	—	—

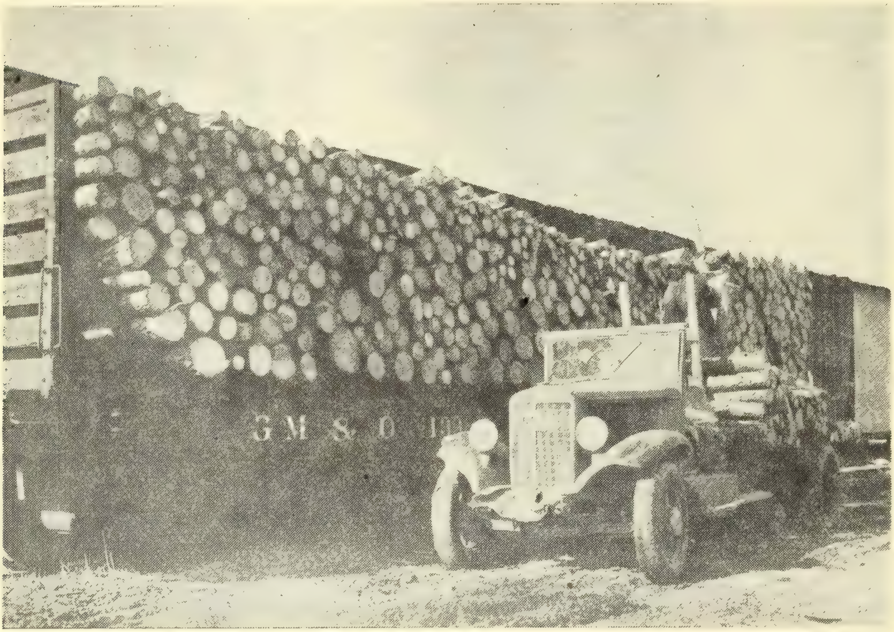


FIGURE 31—Farmer loading pulpwood at Quitman siding of Clarke County Forestry Cooperative.

Figures for the following pulpwood table 18 and columns one and two, basic figures for pulpwood table 19, were taken from the Florida Forest Service Bulletin 12 entitled, "Growing and Marketing Pulpwood."

The approximate number of sticks 5 feet long of uniform diameters at small end to make a unit of pulpwood is illustrated in the following table:

Table 18. Number of pulpwood sticks, of various diameter sizes, required to make a unit.

Diameter of sticks in inches	Number of sticks per unit	Diameter of sticks in inches	Number of sticks per unit
14	22	8	64
12	30	7	82
11	35	6	109
10	42	5	152
9	51	4	228

The following table will show the approximate stumpage value at $2.00 per unit for 1000 round (not worked out for crude gum) standing pines of average heights and various d.b.h. ranging from 5 inches to 14 inches outside bark:

Table 19. Number of pines required to make a unit of pulpwood at various diameter sizes and value of each pine at $2.00 per unit of wood.

Number of pines per unit	d.b.h. of pines in inches	Value of one pine
4	14	$0.50
5	12	0.40
6	11	0.333
8	10	0.25
10	9	0.20
13	8	0.153
20	7	0.10
33	6	0.06
60	5	0.033

For an example of comparative value from the above pulpwood table, it requires 60 of the average pines at 5 inches d.b.h. to make a unit of pulpwood at $2.00 per unit stumpage value, or the stumpage value is a fraction over 3 cents per pine. It requires 5 of the average pines 12 inches d.b.h. to make a unit of pulpwood at $2.00 per unit stumpage value or the stumpage value is 40 cents per pine.

Where timber is sold for pulpwood, it is very much to the farmer's advantage to cut his own timber during odd times and deliver it to the railhead. As shown above, 1000 board feet or 2 units will bring about $3.00 stumpage and $15.20 delivered to the railhead. Practically all farmers have the horse power and equipment necessary to deliver pulpwood to the highway or railhead and by so doing they would probably make good wages. Most farmers can also deliver crossties to the railhead, while only a small percentage might be able to deliver logs, lumber or piling. However, in most cases, they can cut their own timber and hire the logs hauled to the market and make good wages for the time used in cutting and managing these operations. For instance, timber at the present time is about $10.00 per thousand board feet stumpage while logs delivered to the railhead brings about $20.00, thus a farmer gets $10.00 for cutting and delivering his logs, and the chances are the cutting and hauling would cost far less than that amount. Where timber owner and laborers cut and deliver logs and pulpwood on a partnership basis, the owner should furnish the timber and equipment for delivery and receive about 65 percent of the delivered price while labor should receive about 35 percent.

A comparison of the costs of cutting, handling and hauling pulpwood and logs in 1940 and 1945 is shown below in table 20. The increase in costs is significant. However, a large part of costs is for labor. Thus, if a farmer does his own cutting and hauling he can provide a good source of wages for himself and other farm labor during slack farming seasons.

Table 20. Comparison of 1945 with 1940 pulpwood- and log-production costs [1]

Item	Cost in 1940	Cost in 1945	Cost increase	
	Dollars	Dollars	Dollars	Percent
Pulpwood:				
Felling and bucking [2]	1.69	3.69	2.00	118
Loading, unloading, delay [3]	.81	1.52	.71	88
Hauling [3]	.95	2.02	1.07	113
All costs	3.45	7.23	3.78	110
Logs:				
Felling and bucking	1.13	3.23	2.10	186
Skidding	.69	1.34	.65	94
Loading, unloading, delay [4]	.90	1.61	.71	79
Hauling [4]	1.24	2.87	1.63	131
All costs	3.96	9.05	5.09	129

[1] Computed at cost plus 20 percent for profit and risk.

[2] Per standard cord of penned wood.

[3] Per standard cord hauled over 1/2 mile of woods road, 1-1/2 miles of graded dirt road, and 5 miles of gravel road.

[4] Per thousand feet Doyle-Scribner rule for loads averaging 1,400 feet, hauled over 1/2 mile of woods road, 1-1/2 miles of graded dirt road, and 4 miles of gravel road.

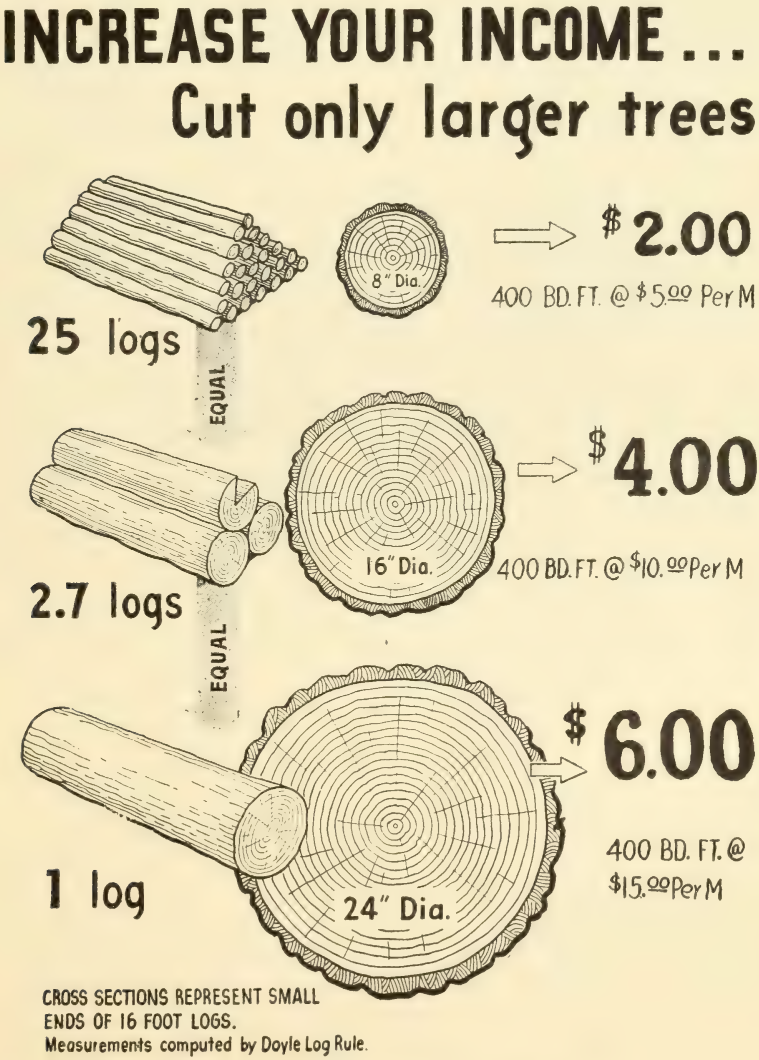
Reference: Occasional Paper No. 107, "Pulpwood-and Log-Production Costs In 1945 as Compared with 1940," page 6, Southern Forest Experiment Station, New Orleans, Louisiana. December 1945.

In summarizing, it might be said that a farmer should sell his timber that is ready for marketing; first, as piling or poles if possible, that is, if it is suitable. Timber that will not make piling or poles should be sold as sawlogs or made into lumber, if it is of sufficient quality, or some of it may be sold for crossties in certain cases. Trees which are large enough but do not meet specifications on either of these three products should be used for pulpwood. In other words, if trees are crooked, limby, or if for other reasons the quality will not permit the production of these products, they can be used for pulpwood or may even be used for fuel wood. This does not mean that pulpwood is not important or that it is not important to have a market for pulpwood because it is very necessary that a large amount of timber be cut because it is cull timber insofar as lumber, crossties, and piling is concerned. It is also necessary that a lot of small timber be thinned in order for the timber left to grow at a maximum rate. In both cases, this timber can be sold for pulpwood whereas it might otherwise be wasted in a large percentage of cases.

COMPARISON OF VOLUME AND VALUE OF VARIOUS SIZE LOGS AND TREES

Unless small trees are crowded, injured, or for some other reason are culls, they should not be cut for market. This is borne out by the fact that, as shown in figure 32, a 16-foot log 16 inches in diameter contains about 9 times as many board feet as a log 8 inches in diameter the same length. Also, a log 16-feet long and 24-inches in diameter has 25 times as much lumber as one 8 inches in diameter. Thus, while a tree triples in diameter it increases in lumber volume 25 times.

At the same time, larger trees are usually higher in price since more valuable timbers can be cut from larger trees. Thus, it is estimated that a 24-inch log 16 feet long would bring $3.60 compared to $1.20 for 25 eight-inch logs with the same number of board feet. In other words, one 16-foot log 24 inches in diameter has the same value as 75 logs the same length and 8 inches in diameter. It may not be practical for farmers to grow 24-inch trees but these figures and illustrations are evidence enough that the forests should be managed so that the harvest trees will be as large as possible and practical. As long as conditions are such that trees will make a normal or economical growth, they should not be harvested unless financial conditions demand it.


INCREASE YOUR INCOME...
Cut only larger trees
25 logs
8" Dia.
$2.00
400 BD. FT. @ $5.00 Per M
EQUAL
2.7 logs
16" Dia.
$4.00
400 BD. FT. @ $10.00 Per M
EQUAL
1 log
24" Dia.
$6.00
400 BD. FT. @ $15.00 Per M

CROSS SECTIONS REPRESENT SMALL ENDS OF 16 FOOT LOGS.
Measurements computed by Doyle Log Rule.

FIGURE 32—Volume and value of small trees compared to larger trees

Should I sell *all* my timber now so as to take advantage of present high prices of timber? This is one question often asked by farmers. They have a tendency to do just that when prices are high.

According to the chart below, a 10-inch tree is worth 20 cents as a sawlog, at a stumpage price of $10.00 per thousand board feet, Doyle scale. A farmer, with such trees, may sell now and get 20 cents or he may leave it and take a chance that prices will be lower in the years to come. If he sells, it will take about 30 years to replace a 10-inch tree.

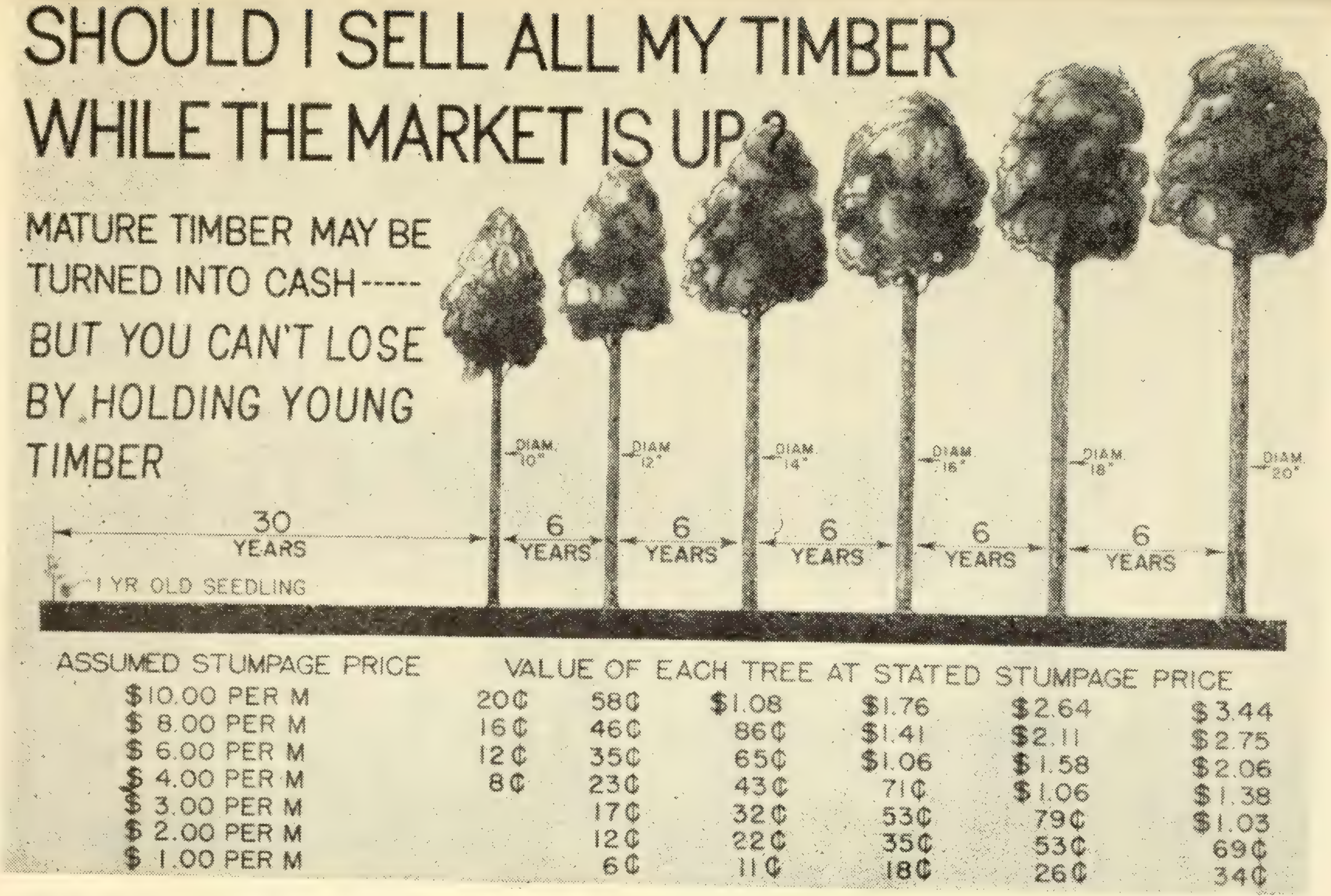
If he leaves the tree 6 years to grow into a 58-cent tree with no change in stumpage values, it is worth more money than the 10-inch tree now plus another 10-inch tree 30 years from now, assuming prices to remain as they are now. Then if prices remain high for 30 years, he might leave the same tree and it would be worth $3.44; whereas, two 10-inch trees would only bring 40 cents at the same stumpage prices.

Taking a pessimistic view, however, one might assume that prices will drop to the depth of $1.00 per thousand board feet. In this case the 10-inch tree, if left to grow 30 more years, would be worth only 34 cents. On the other hand, if it were cut now, bringing 20 cents and another 10-inch tree is grown in its place it would be worth only 2 cents. So the two 10-inch trees would be worth only 22 cents compared with 34 cents if the tree is left to grow another 30 years.

In addition, if the 10-inch tree is left standing 30 years, becoming 20 inches in diameter, it may be sold for poles or piling which bring, as a rule, about a 30 percent higher price than sawlogs.

Then too, when timber prices drop, prices of other commodities are likely to drop in the same proportion. If so, the returns from a given size tree may have the same proportionate buying power as it has at the present price level.

Reference: "Texas Forest News," Texas Forest Service, A. & M. College. College Station, Texas, October-November, 1945, page 5.



SHOULD I SELL ALL MY TIMBER WHILE THE MARKET IS UP?

MATURE TIMBER MAY BE TURNED INTO CASH----- BUT YOU CAN'T LOSE BY HOLDING YOUNG TIMBER

ASSUMED STUMPAGE PRICE	VALUE OF EACH TREE AT STATED STUMPAGE PRICE					
$10.00 PER M	20¢	58¢	$1.08	$1.76	$2.64	$3.44
$ 8.00 PER M	16¢	46¢	86¢	$1.41	$2.11	$2.75
$ 6.00 PER M	12¢	35¢	65¢	$1.06	$1.58	$2.06
$ 4.00 PER M	8¢	23¢	43¢	71¢	$1.06	$1.38
$ 3.00 PER M		17¢	32¢	53¢	79¢	$1.03
$ 2.00 PER M		12¢	22¢	35¢	53¢	69¢
$ 1.00 PER M		6¢	11¢	18¢	26¢	34¢

FIGURE 33—Value of pine trees at various ages and sizes with stumpage prices varying from $1.00 to $10.00 per thousand board feet. Courtesy: Texas Forest Service.

ESTIMATING AND SELLING TIMBER

Growing timber or other forest products is a business in the same sense as farming, cattle raising, operating a filling station, running a store, or any other similar business. Success or failure is measured by the amount of income derived from the enterprise over and above the cost of operation or production. It is just as important for a timberland owner to know the amount of standing timber he has for sale and its approximate value as it is for the farmer to know the number of bales of cotton he has produced and the market price per pound at the time he is ready to make a sale. Without this knowledge, it would be impossible to dispose of the crop, whether it be timber or agricultural products, at a price that would justify continuation in business.

It has been the rule rather than the exception that the majority of timber sales, particularly those embracing small acreages, have been made without the owner or seller having any conception of the quantity or value of timber included in the transaction. The results in many instances have been discouraging to the seller and, as a consequence, he has permitted his lands to be abused by overcutting, uncontrolled forest fires, and indiscriminate grazing.

In order to obtain the most for his timber, the owner should have a reliable estimate and appraisal made either by himself or a competent timber cruiser. The Agricultural Extension Service has farm foresters assisting farmers in 16 counties with this type of farm forestry work. Any group of farmers desiring help on how to estimate timber, how to harvest timber, how to determine which trees to sell and where to sell them, may arrange for a neighborhood or community demonstration to be held in the woods on the interested farmer's land. The U. S. Forest Service, the Soil Conservation Service, and the Mississippi Forest Service all have foresters helping farmers with their woodland problems. The farmer can arrange to get this type of service through his vocational teacher, his county agent, area ranger and by writing direct to the extension forester, Mississippi State College, State College, Mississippi. Furthermore, increased profits may be realized from the timber operation when the owner does his own cutting and hauling provided he has suitable equipment for this type of work.

The old time timber cruiser or "land looker" and to a limited extent his present day counterpart, has sometimes surrounded himself with an air of mystery that has more or less baffled the average person who is unfamiliar with such terms as board feet, log scale, Doyle rule and lumber tally. When the task of timber cruising is clearly viewed, it is found that basically the determination of timber volumes is common sense plus simple arithmetic.

ESTIMATING TIMBER

There are four principal units of measurement which are used in estimating and selling timber, namely:

1. *Board foot* Represented by a board one foot long, one foot wide, and one inch in thickness.

2. *Linear foot.* A foot in length without regard to width or thickness.

3. *Cord.* A pile of wood 4 feet wide, 4 feet high, and 8 feet long, containing 128 cubic feet.

4. *Piece.* A single unit of any timber of a kind which is sold by unit pieces, such as fence posts and railroad ties. Lumber and logs are measured in terms of board feet, poles and piling by linear feet, fuel wood and pulpwood by cords.

A log rule is nothing more or less than a table which gives the estimated or calculated amount of lumber which can be sawed from logs of given lengths and diameters. Numerous log rules have been developed over the years and needless to say each gives a different calculated quantity of lumber which can be sawed from a log. Scribner, Scribner-Decimal C., International, and Doyle are some of the more commonly used log rules. The Doyle rule is most frequently used by lumbermen in Mississippi in measuring timber and logs although some sellers insist on the International rule. The Doyle rule favors the buyer in small size timber for the logs will actually saw out more lumber than the rule gives while the International rule gives a very close approximation to the amount of lumber that can be cut from a log. However, with a full understanding of the comparative values for each rule it really makes very little difference which rule is used. In practice the contents of logs are measured with a scale stick which is graduated in inches on the edge and shows for logs of different diameters and lengths the corresponding contents in board feet according to a given log rule. If a sale of logs is based on the Doyle rule, a scale stick with the Doyle rules values thereon must be used. The diameters of the logs are measured at the small end and inside the bark, although in some localities it is customary to include the measurement of one bark when scaling by the Doyle rule. The Doyle rule and the International rule are given in the tables that follow.

Doyle Rule (Log Scale)

Diameter at small end of log inside bark (inches)	Length of logs in feet						
	8	10	12	14	16	18	20
	Board feet in logs						
6	2	3	3	3	4	4	5
7	5	6	7	8	9	10	11
8	8	10	12	14	16	18	20
9	12	16	19	22	25	28	31
10	18	23	27	32	36	41	46
11	24	31	37	43	49	55	61
12	32	40	48	56	64	72	80
13	40	50	61	71	81	91	101
14	50	62	75	88	100	112	125
15	60	75	91	106	121	136	151
16	72	90	108	126	144	162	180
17	84	106	127	148	169	190	211
18	98	122	147	171	196	220	245
19	112	141	169	197	225	253	280
20	128	160	192	224	256	288	320
21	144	181	217	253	289	325	361
22	162	202	243	283	324	364	404
23	180	226	271	313	359	406	452
24	200	250	300	350	400	450	500

International Rule (Log Scale)

Diameter at small end of log inside bark (inches)	Length of logs in feet						
	8	10	12	14	16	18	20
	Board feet in logs						
6	10	10	15	15	20	25	25
7	10	15	20	25	30	35	40
8	15	20	25	35	40	45	50
9	20	30	35	45	50	60	70
10	30	35	45	55	65	75	85
11	35	45	55	70	80	95	105
12	45	55	70	85	95	110	125
13	55	70	85	100	115	135	150
14	65	80	100	115	135	155	175
15	75	95	115	135	160	180	205
16	85	110	130	155	180	205	235
17	95	125	150	180	205	235	265
18	110	140	170	200	230	265	300
19	125	155	190	225	260	300	335
20	135	175	210	250	290	330	370
21	155	195	235	280	320	365	410
22	170	215	260	305	355	405	455
23	185	235	285	335	390	445	495
24	125	255	310	370	425	485	545

A volume table shows, for a given species, the average contents of trees of given sizes in a specific unit of volume.

Estimating the volume of a tree comprises the measurement of the diameter of the tree to the nearest even inch at a point 4½ feet above the ground and estimating the total height of the tree or the number of merchantable 16-foot logs it contains, depending upon whether the volume table to be used in computing volumes is based on total height or the number of logs in the tree.

There are numerous instruments that have been designed for use in timber estimating. For instance, a pair of tree calipers or a diameter tape may be used to measure diameters and a hypsometer or an Abney Level to measure heights. Recently a "cruiser's stick" has found considerable favor among estimators. This stick may be used to measure diameters as well as heights by following a few simple instructions. Most county agents, the extension forester, vocational agriculture teachers or the state forester have "cruiser's sticks" which may be secured on temporary loan or purchased for about fifty cents. After the tree measurements have been made, the board contents of the tree may be obtained from the volume table by reading the volumes corresponding to the individual tree measurements.

The following tables give tree volumes for second-growth Southern pine and have general application for most sections of Mississippi. One table is based on the Doyle rule and the other the International rule. (As pointed out previously, the Doyle rule gives values somewhat lower than the International for trees up to 30 inches d.bh., above 30 inches the Doyle gives the greater scale.) These tables should be used only for pine and if oak, gum or some other species is to be cruised, volume tables for these species should be secured by writing to the state forester, extension forester, or by contacting local county agent or teacher of vocational agriculture.

International Rule (Tree Scale)
Second-Growth Southern Pine-Form Class 80 1/

Diameter of tree 4-1/2 feet above ground in inches	Number 16-foot logs 1	2	3	4	5
10	39	66			
12	59	107	146		
14	80	149	197		
16	110	200	259		
18	140	250	330	380	
20	180	320	420	480	
22	220	390	520	600	
24	260	480	630	730	810
26	310	580	760	880	1000
28	360	690	910	1050	1190
30	430	810	1070	1220	1410

Form class of a tree may be defined as the percentage the diameter inside bark at the top of the first 16-foot log bears to the diameter at breast height: Form Class = D.I.B. at 16 feet X 100.
D B.H.

Doyle Rule (Tree Scale)
Second-Growth Southern Pine-Form Class 80 1/

Diameter of tree 4-1/2 feet above ground in inches	Number 16-foot logs				
	1	2	3	4	5
10	16	25	--------	--------	. .
12	31	54	70	--------	--------
14	49	89	112	--------	--------
16	76	134	165	188	--------
18	110	190	230	260	--------
20	140	240	310	360	--------
22	180	310	410	470	----
24	220	400	530	600	640
26	280	510	670	760	810
28	330	620	820	920	1010
30	390	750	970	1090	1210

1/ Form class of a tree may be defined as the percentage the diameter inside bark at the top of the first 16-foot log bears to the diameter at breast height: Form Class $= \frac{\text{D.I.B. at 16 feet X 100.}}{\text{D.B.H.}}$

Example: A tree 15 inches in diameter at breast height has a diameter inside bark of 12 inches at height of 16 feet: $\frac{12}{15}$ X 100 = 4/5 x 100 or 80. Therefore the form class is 80.

Timber with a form class higher than 80 will have slightly more volume than shown in volume tables above and timber with a lower form class will have less volume than shown in these tables.

Cubic foot estimates of standing trees for fuelwood or pulpwood may be made by applying the individual tree measurements to the following volume table:

(Top utilization, i. e., merchantable length of tree in feet, is assumed to average 5 inches outside of bark, varying from 3.8 inches to 6 inches.)

Volume table for estimating pulpwood and fuelwood in cubic feet

Diameter of tree, 4-1/2 feet above ground (inches)	Merchantable height of tree in feet													
	12	16	20	24	28	32	36	40	44	48	52	56	60	64
	Cubic* foot of volume (including the bark)													
6	1.6	2.2	2.7	3.2	3.8	4.3	4.8	......	......	......	......	......	......	......
8	......	3.6	4.6	5.5	6.4	7.3	8.3	9.1	10.1	11.0	......	......	......	......
10	......	......	6.8	8.2	9.5	10.8	12.3	13.6	14.9	16.3	17.7	19.0	20.4	......
12	......	......	......	11.2	13.0	14.9	16.7	18.6	20.5	22.3	24.2	26.0	27.9	29.8
14	......	......		......	16.8	19.3	21.7	24.0	26.5	28.9	31.3	33.7	36.1	38.5
16	......	......		......	......	23.8	26.9	29.8	32.8	35.8	38.8	41.7	44.7	47.7

*Cubic feet may be converted into standard cords containing 128 cubic feet by dividing by 90. There are actually only 90 cubic feet of solid wood content in a cord of wood piled 4' x 4' x 8' and since the values from the volume tables are solid wood content, a converting factor of 90 is used. For units of 144 cubic feet and 160 cubic feet divide by 102 and 113, respectively.

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The tree scale volume tables given were taken from "Volume Tables, Converting Factors, and Other Information Applicable to Commercial Timber in the South," prepared by Region 8, U. S. Forest Service.

In estimating standing timber it is necessary to use some form of tally sheets. Suggested sawlog tree and pulpwood tally sheets are shown below:

Sample sawlog tree tally sheet

D.B.H. (Inches)	1 Log	2 Logs	3 Logs	4 Logs
10				
12	111			
14				
16		1111		
18			1	
20				
22				
24				
TOTALS				

Sample pulpwood tally sheet

D.B.H. (inches)	Number trees							
	Merchantable height in feet							
	12	16	24	32	40	48	52	64
4								
6								
8								
10								
12								
14								
16								

The units of "linear feet" or "pieces" in standing trees are determined by actually counting the linear feet or the pieces that can be cut from the individual tree. It usually requires more training and skill to properly estimate the quantity of such specialized products than it does to estimate board foot or cubic foot contents. However, the owner should attempt to acquaint himself with market conditions for specialized products as they frequently bring a premium over and above that which could be obtained if all the trees are cut into sawlogs.

To estimate the amount of board feet or number of specialized products which can be cut from a woodland tract of small area, it is desirable to make an estimate of each tree. Totals for each species should be obtained since there are ordinarily considerable variations in prices for the various kinds of timber.

There are several ways of estimating standing timber. Some of these require special equipment and technical training neither of which may be practical for the average farmer to have. The "circular plot cruise" or the "strip cruise" is entirely practical for the average farmer to use. A detailed discussion and instructions for making estimates by these two methods are given below:

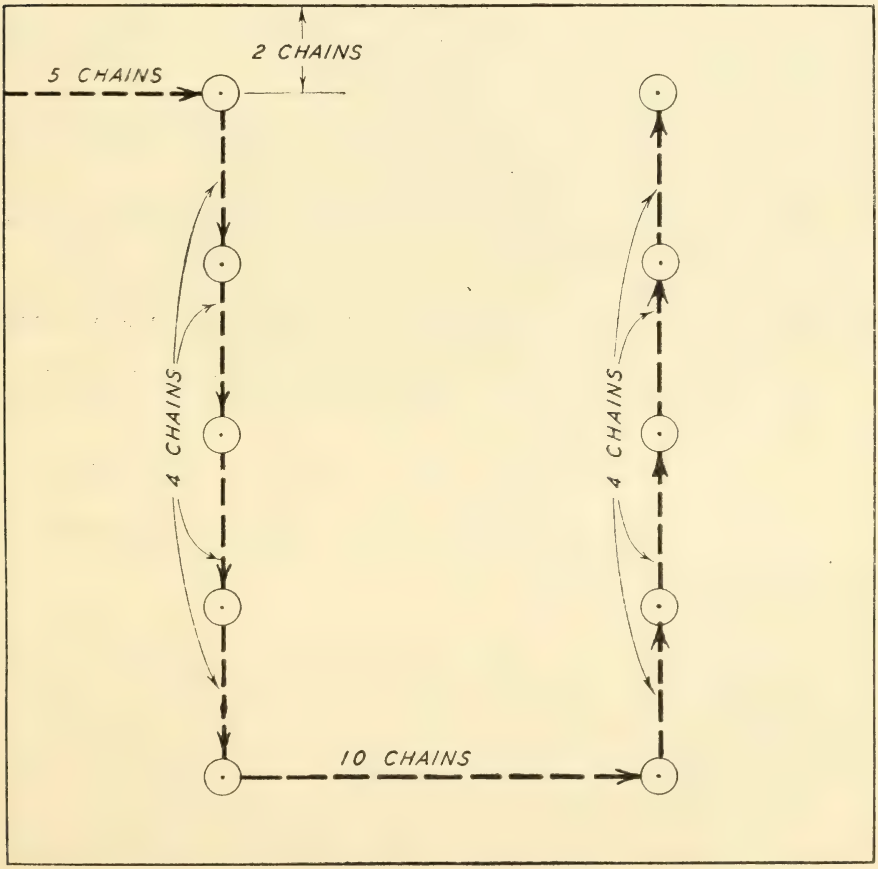

FIGURE 34—Diagram of circular plot cruise. (40-acre plot).

Circular plot cruise. Following the drawing above, directions are given at this point for estimating 40 acres of timber by the circular plot cruise:

1. Begin at the northwest corner of the plot, measure 5 chains east which is the beginning point of the cruise.
2. Measure 2 chains south and at this point draw a circle with a 52.7 foot radius and estimate timber within this circle.
3. Continue 4 chains south and repeat the estimate.
4. Continue this process until 5 circular plots of timber are estimated. The first and last plots will be 2 chains from the 40 line and the remainder will be 4 chains apart.
5. When the number 5 plot is estimated (which will be 2 chains from the S-40 line), go east 10 chains, and make another circular plot estimate.
6. Then go north 4 chains at a time, and make similar counts until 5 counts are made, the number 5 being 2 chains from the N-40 line and 5 chains from the E-40 line.

This will give a 5 percent cruise, therefore, to estimate the total timber on the entire plot, multiply the sum total of the 10 plots estimated by 20.

The number of board feet in these plots of course may be estimated by the use of tables on pages 87-89 and with certain types of instruments if a person desires to use instruments.

Strip cruise. In making the strip cruise the drawing and directions below may be followed:

1. Go to a point 5 chains east of the northwest corner of the plot and measure a strip 1 chain or 66 feet wide all the way across the 40-acre plot or whatever the size of the plot may be.
2. Then measure 10 chains east (which will be 5 chains from the east side) and measure another strip 66 feet or one chain wide all the way across the plot.
3. Tally all merchantable trees on each strip as the strips are run.
4. Since this is a 10 percent cruise, multiply the sum total of board feet obtained from the volume table in the strips by 10 to get a total estimate of board feet on the entire area.

The directions above were given beginning at the northwest corner, however, one can begin from any corner in the plot and make a similar cruise; in fact, where the strip cruise is made, the strips should run at right angles to streams or rivers in order to get a fair estimate of the different kinds of timber. This is true because if part of the land is on the hills and part of it in the bottoms, there are usually different types of timber growing on these elevations. Thus, if the strips ran parallel to the streams the estimate might show all hardwood or all pine timber depending on whether the strips were in the bottoms or on the hills.

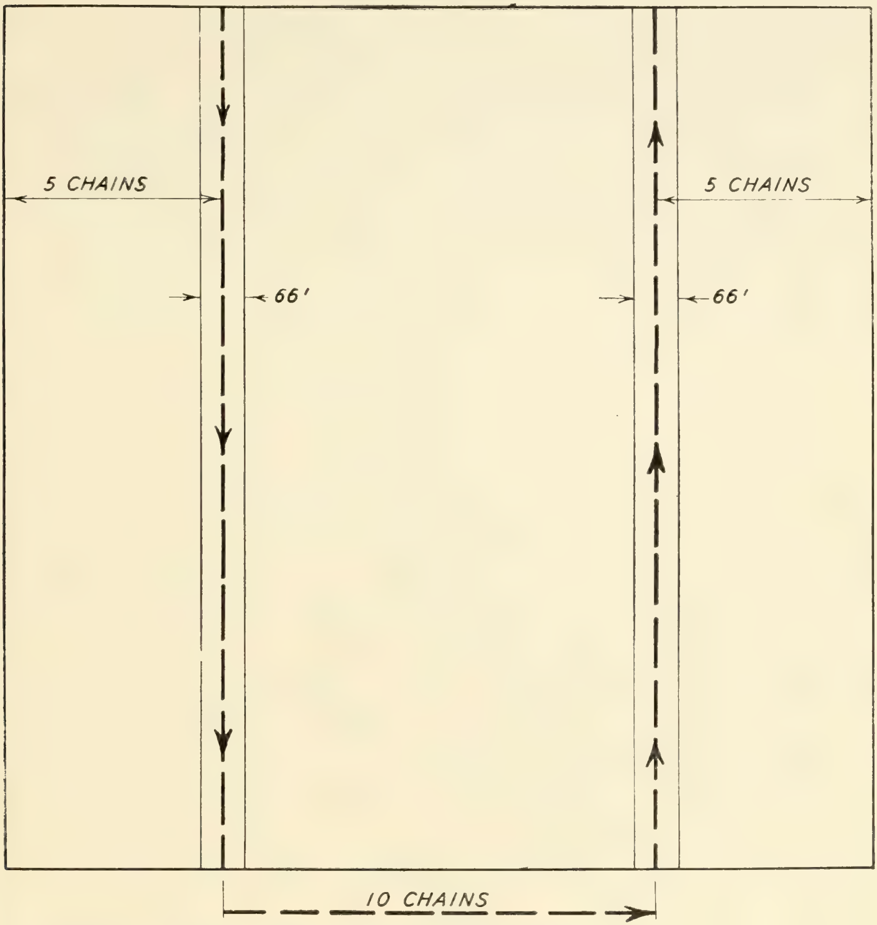

FIGURE 35—Diagram of strip plot cruise. (40-acre plot).

The circular plot method described above gave a 5 percent estimate. The strip method gave a 10 percent estimate. By changing the number of cruise lines which are run across a fourth, or by changing the size of plot or width of strip, the percent estimated by either method could be varied. Any partial estimate is, of course, subject to some error, because the sample taken may not happen to represent truly average conditions. This is particularly true of small woodlots which contain a variety of kinds and sizes of timber. In spite of the possibility of error in such mechanical sampling, the ordinary landowner will do better to stick to one of these methods rather than to attempt to pick out, by using his own judgment, a sample acre or two representative of the whole tract. Even experienced timber cruisers have difficulty in doing this. For small woodlots of considerable value, that is, those containing a large proportion of good sawlogs, poles, or piling, it may well be worth the owner's while to make a 100 percent estimate, actually tallying every tree.

Trees to be harvested selectively should be double marked for cutting at the time the measurements are made. The marking may be indicated by an axe blaze, brand, or paint spot (the latter is preferred) at a point below stump height and at breast height. The top mark indicating the tree is to be cut and the lower spot serves as a check on the cutters. This method will permit the sellers to offer only the marked trees for sale. Furthermore, the owner will be able to reserve desirable trees for future cutting and for seed tree purposes and at the same time have a reliable means of checking the cutting operations against the terms of the sale contract.

SELLING TIMBER

The price received for standing timber is primarily dependent upon the quality of the timber, distance from markets, and the difficulties of logging. In planning a timber sale a thorough investigation of available markets should be made with the view of contacting operators qualified to utilize the timber to the best advantage. It is a good policy to get as many different buyers as possible including those out of the area where the timber is located, to bid on the timber.

The sale of timber should always be covered by a written agreement or contract signed by the owner and the purchaser with signatures witnessed and notarized. A properly executed contract will eliminate misunderstandings and provide protection to the buyer as well as the seller. A timber sale contract should give the location of the timber by legal subdivision, method of cutting, schedule of payments, period allowed for cutting, and the responsibility of the buyer for protection against fire or other unnecessary damage.

References: (1) Alabama State Chamber of Commerce Bulletin "Green Gold of Alabama's Forests," page 64 to 70, in cooperation with the Division of Forestry, Southern Pine Association, Department of Vocational Agriculture, Alabama State Planning Commission and the American Products Industries. (2) Extension Mimeograph "Information For Use In 4-H Club Forestry Contests," Agricultural Extension Service, State College, Mississippi, December, 1945. (3) Occasional Paper Number 107, "Pulpwood and Log Production Costs in 1945 as Compared with 1940," page 6, Southern Forest Experiment Station, New Orleans, Louisiana, December, 1945.

UTILIZATION OF TIMBER ON THE FARM

A good percentage of farm timber is used and possibly more should be used on the farms and locally for (1) the construction and repair of farm buildings, (2) fuel wood, and (3) production of charcoal and other miscellaneous products. Maximum use of farm timber for these uses should make for: (1) better living conditions, (2) use of available farm labor, and (3) use of otherwise, in many cases, cull trees. Each of the above named uses for farm timber is discussed separately below.

FUEL WOOD

The big increase in the demand for coal required by industry and the heavy load that the transportation systems are bearing have turned more attention to wood for fuel.

Several classes of material make up the potential supply of fuel wood. Because of the widespread practice of leaving poor trees uncut, there has accumulated in Mississippi forests a vast number of culls unfit for sawlog use either now or later. On an average, an acre of Mississippi forest land bears at least a cord of cull material good only for fuel.

In logging and in milling forest products, a large volume of wood is cast aside in such forms as tops, limbs, slabs, edging, and ends. Some of this waste from milling operations is already being utilized for fuel, or sold as by-products. Little of the waste in the forest, however, is now recovered. A great deal of this wood could and should be utilized for fuel and will reduce forest-fire hazards.

Not all of our timber crop reaches maturity. Each year in the United States more than 2 billion cubic feet of timber is killed by such destructive agencies as fire, insects, and disease. A high proportion of these trees would make excellent fuel wood if used before decay advanced very far.

As pointed out earlier in this bulletin another excellent way to obtain fuel wood is to weed the undesirable trees from the woodlands and thin out the over dense stands. Inferior species and suppressed trees are often entirely satisfactory as fuel.

According to the 1940 Census the average size of farms in Mississippi was 65.8 acres. It is estimated that 10 million acres are in farm woodlands, and as is estimated and pointed out elsewhere in this bulletin. An average of about 34 of the 65.8 acres per farm is in forests and there were 291,092 farms in Mississippi the same year. If every farmer would cut all of his fuel wood from these trees that are unmerchantable or those that are crowding or shading small trees, cutting those that are doing the worst damage first and continue this process, they could probably make all the improvement and liberation cuttings necessary and bring their timber into good growing conditions in this way in less than 10 years. The average farmer probably uses more than 10 cords of fuel wood annually. Therefore, it would not take long to cut out the undesirable wolf trees and those that are suppressing growth of the good clean growing stock on 34 acres of land if all the fuel wood was secured from this type timber.

Production of fuel wood can therefore be made to yield twofold returns in connection with good forestry practices such as making improvement cuttings, thinning and salvaging dead and down trees promptly. Properly carried out, these operations would do more to conserve the values in Mississippi forests, as a whole, than any other measure except fire protection. Similarly, the use of mill waste as fuel not only increases opportunities for immediate profit but tends to conserve natural resources.

Comparison of heating value of different woods. Moisture in the wood is the most important factor in the heating value. When wood is burned, the water in it must be raised to the boiling point, converted into steam, and finally superheated to the temperature of the flue gases. Hence the heat required to drive off the moisture does not serve to warm the stove or furnace. Generally from 25 to 45 percent of the weight of green wood is water, and in such species as cottonwood and willow it may even be 55 to 60 percent. By drying out much of this water, the heating value of the wood is considerably increased. For example, green shagbark hickory weighs about 800 pounds more per cord than air-dried wood of the same species, the difference representing mostly water. Table 21 below shows that this extra moisture reduces the heat value about one-sixth. This table also shows the comparison of the available heat in various woods, both green and air-dried as well as tons of coal required to equal one cord of each kind of wood.

Table 21. Approximate heating value per cord 1/ of different woods, green and air-dried 2/

(Data supplied by Forest Products Laboratory, Madison, Wisconsin)

Species	Available heat (B.T.U.) 3/		Equivalent in coal 4/	
	Green	Air-dry	Green	Air-dry
	Million B.T.U.	Million B.T.U.	Tons	Tons
Ash	16.5	20.0	0.75	0.91
Beech, American	17.3	21.8	.79	.99
Elm, American	14.3	17.2	.65	.78
Hickory, shagbark	20.7	24.6	.94	1.12
Maple, red	15.0	18.6	.68	.85
Oak, red	17.9	21.3	.81	.97
Oak, white	19.2	22.7	.87	1.04

1/ Containing 80 cubic feet of solid wood.

2/ Air-dry means with 20 percent moisture in terms of oven-dry weight, or 16.7 percent in terms of total air-dry weight.

3/ One B.T.U. (British thermal unit) is the amount of heat required to raise the temperature of 1 pound of water 1 degree F. Available heat equals calorific value, minus loss due to moisture, minus loss due to water vapor formed, minus loss in heat carried away in dry chimney gas. Flue temperature 450 degrees F.; no excess air.

4/ Heat value of coal under similar conditions taken as 11,000 B.T.U. per pound of dry coal. Tons of 2,000 pounds.

References: (1) U. S. Department of Agriculture Farmers' Bulletin No. 1912 "Wood Fuel in Wartime," pp. 3, 4, 5, 6, 7, 9, and 10. (2) U. S. Agricultural Census, Mississippi First Series, County Table 1, Washington, D. C., 1940.

FARM BUILDINGS

Many farmers with timber on their land suitable for sawing into lumber have overlooked the opportunity to construct good farm buildings. Some, who have been cutting and selling timber for years, have not learned to utilize their forest products and labor resources for the improvement of their own farm buildings. Others have not been able to finance the structures necessary for the successful operation of their farms. When materials and labor must be purchased, and the cash income from the farm is low and hardly takes care of family needs, there is little prospect of making extensive repairs or erecting new buildings. Consequently, the condition of farm structures has steadily deteriorated in Mississippi until many of them are in poor condition and some unfit for habitation. A large percentage of the farmhouses in Mississippi have poor roofs, chimneys, walls, foundations, and should be replaced with new buildings or given major repairs. Many are in fair living condition but need some repairs; while others are in good condition, requiring only general maintenance.

In some communities farmers have pointed the way to a practical solution of the rural housing problem through a self-help program, using native materials, such as timber, stone, sand, and gravel, available on the farm or in the locality.

LUMBER

Wood is a natural building material in Mississippi. Frequently, in cutting timber for sale, farmers reserve a few of their larger, straighter trees—often called "board trees"—to meet future lumber needs; hence, the farm woods can rightfully be regarded as insurance on farm buildings. Farmers have shown that by using homegrown timber, repairs can be made and new buildings constructed without resorting to a mortgage or other burdensome indebtedness, and without using funds needed for carrying on farming operations. The growing of a few large "board trees" should therefore have a place in the management of every farm.

Mississippi has a number of hardwoods and pines suitable for farm construction. Some of the more important woods are given in table 22 along with lumber uses, sizes of material, and specifications. The term "southern pine" includes several species, such as longleaf, slash, loblolly, and shortleaf. It is important to have lumber well manufactured and to use air or kiln-dried stock as specified.

Table 22. Uses of Mississippi woods in farm buildings.

Use	Size 1/	Specifications 2/	Suitable woods 3/
Sills, (untreated)	6" x 6" and larger	Sound, hewn or sawed square, air-dried. Bark should be removed.	White oak, locust, heart cypress, or heart long-leaf pine.
Sills (treated with preservative)	6" x 6" and larger	Sound, hewn or sawn squares air or kiln-dried	Sap pine, sap cypress, red oak, or any other available woods when treated.
Timbers, beams and stringers	5" (or thicker) by 8" (or wider)	Sound, hewn or sawn square, air-dried. Bark should be removed.	White oak, locust, heart cypress or heart long-leaf pine, red oak, and others.
Joists, rafters, and trusses.	2" to 4" thick by 4" (or wider)	Sound, square-edged, air dried. May be used rough or dressed.	Pine or hardwoods.

Table 22 (Continued). Uses of Mississippi woods in farm buildings.

Use	Size 1/	Specifications 2/	Suitable woods 3
Roof boards and sheathing	1" x 6", 1" x 8", and 1" x 10"	Sound, square-edged, air-dried, dressed.	Pine or hardwoods
Studding, plates	Usually 2" x 4" and 2" x 6"	Sound, square edged, air dried. May be used rough or dressed.	
House siding	Any standard pattern desired.	Kiln-dried, drop or or bevel siding.	Cypress, or pine.
Barn siding (and for other out-buildings)	1" x 8", 10", or 12" wide	Common boards with sound tight knots, air-dried. Applied vertically with battens.	Pine, cypress, or any available hardwood.
Exterior house trim	1" x 2" to 1" x 6" and moulding	Sound, clear, square-edged kiln- or air-dried	Cypress and pine.
Sub-flooring	1" x 6", 1" x 8", and 1" x 10"	Common boards, sound, air-dried, rough or dressed	Pine or hardwoods.
House flooring (hardwood)	Face width 1½", 2", 2 1/4", and 3 1/4"	Kiln-dried stock of grade desired, flat or vertical grain	Oak, pecan, beech, birch, and hard maple.
Plank flooring (for barns)	2" x 8", 2" x 10", 2" x 12"	Sound, strong, air-dried square-edged	Cypress, pine, or hardwoods.
Gates and fences	1" x 4" or 6"	Sound, light weight, air-dried, square-edged, rough or dressed	Cypress, pine, or hardwoods.
Tanks and vats	Various sizes of boards	High grade heartwood free of knots, air- or kiln-dried, rough or dressed	White oak, cypress, pine, or cedar.
Fence posts	3" diameter and up 6' to 7' long	Sound, durable, bark should be removed. Less durable woods should be treated with preservative	Osage orange, locust, red cedar, mulberry, white oak, heart cypress. (Most other woods should be treated.)
Shingles	Random or standard width 16", 18" or 24" long	Sound, edge-grain, sawed or split, air-dried. Less durable woods should be treated with preservatives	Cypress, pine, white oak, and other desirable woods.

1/ The sizes of lumber items to be used will be determined by the building plans.

2/ High-grade air- or kiln-dried stock, such as house siding, trim, flooring, and special purpose items needed in farm construction, can usually be obtained at retail lumber yards.

3/ Only the commonly used woods are listed. Others suitable for the purpose can be used.

Reference: U. S. Department of Agriculture Farmers' Bulletin No. 1975, "Farm Building from Home-Grown Timber in the South," pp. 1, 2, and 17, Washington, D. C., September 1945.

LOGS AND POLES

These products can be employed advantageously in the building of dwellings and other farm conveniences where timber is plentiful. This method of construction permits utilization of local material and labor.

The principles of log construction are few and simple. However, they are not well understood by the general public of today. Some suggestions are given below as to selection of trees, logs and species, and it is believed that one should have little difficulty in planning an attractive home as well as other useful structures.

Selecting trees for logs. Before starting construction, a thorough survey of the woodland should be made to determine the number, species, and size of trees available, and their sale value. Many species of trees have commercial value which warrants their being left standing until convenient to market. By following this procedure, considerable money might be available later for defraying the expense of building, or for other purposes; also, such a survey will be of help in determining the design of the proposed structure.

Suitable species. As a matter of economy one should as far as practicable use the trees found on the site. Pine is a very good species for building purposes. Short-lived woods like the cottonwood and willow, unless very thoroughly protected from dampness, are not so suitable. Cedar is excellent but might be valuable if good markets are available. Many of the hardwoods are almost as desirable but are less frequenty used, chiefly on account of their weight and hardness. Other species can be used, but it is advisable to choose the more durable woods and, for the sake of appearance, to employ the same species in like parts of the building.

Size of logs. Logs of from 4 to 10 inches in diameter are usually employed, yet larger logs are not uncommon. It is desirable, though not essential, that the logs have only a slight taper. The length of the logs should preferably be a little greater than a length of a room, to allow for intermembering; tree trunks longer than 20 feet are heavy and difficult to handle, they are seldom necessary since the length of a room does not often exceed 20 feet. While logs used in a wall can be spliced by halving the abutting ends, this is not considered good practice as it weakens the wall and detracts from the appearance. Short lengths can be utilized for panels between wall openings. By careful designing, detail can be worked into a structure so as to make use of a large number of short lengths of small diameter logs, thus utilizing to advantage a limited supply of timber and at the same time effecting a saving in the large trees and in the amount of labor required in building.

Reference: U. S. Department of Agriculture Farmers' Bulletin No. 1660, "The Use of Logs and Poles in Farm Construction," pp. 1 and 2, Washington, D. C., September, 1940.

CHARCOAL

Charcoal is a valuable product of the forest. It may be produced on certain farms at least to provide farm and local needs, or in some cases it may be produced on a commercial basis.

Charcoal should be produced from cull timber, thereby increasing the farm woodland income and increasing growth of the better trees.

Directions below might be helpful to the average farmer who is interested in making charcoal on a small scale.

By this procedure as little as one cord of wood can be used at a burning and only one day is required to burn a cord in kiln.

Steps in making charcoal:

1. Cut poles 3 to 8 inches in diameter by 8 feet long, mostly 6 to 8 inches in diameter.

2. Lay one of the larger logs flat on the ground. Lay another of the larger logs parallel to the first one, leaving an air space between them of about three-fourths of the diameter of the log and fill said space with kindling, such as grass, leaves, twigs, and small limbs. Lay another of the larger logs on each side of the first logs and against them on the ground.

3. Build the pile up by placing pole above pole or log on top of log in an oval or half round shape. Lay the smaller poles next to the outside and on top—fartherest from the center of starting fire.

4. Slope the ends up by using short sticks with kindling wood between on the bottom to extend the first pile of kindling to out-ends of kiln.

5. Cover with brush, weeds, pine straw, canes, or whatever similar materials is handy, to hold up a layer of sod dirt. Then cover with the first layer of sod dirt, turned upside down.

6. Then add another layer of brush and another layer of sod until the kiln is well covered, of course, leaving the ends of the kindling exposed through holes in the dirt.

7. Set the kindling afire early next morning or the same morning but not later than nine o'clock for pine—perhaps earlier for oak and other hardwood, if you do not wish to sit up and watch the kiln until it burns down.

8. When kiln gets to burning good, place brush or a large chunk of wood over the kindling hole at one end of kiln and cover with sod dirt until no smoke gets out at that place. Then do the same at the other end of the kiln.

9. Allow gray smoke to ooze out all over kiln all of the while until the kiln caves in. But if a hole comes in kiln allowing black smoke to escape, put a large chunk of wood, if necessary, and more dirt until it is stopped.

10. Six to 8 hours later the kiln should fall in and it will also quit smoking. Then about one hour later, tramp all over it thoroughly. Place plenty of dirt at ends and elsewhere, if it is needed, to keep out wind or air.

11. Next morning, rake all dirt off and pour in plenty of water (if fire starts up, pour in more water). Sack up and use. Kiln should be near a creek, pond, lake, or some other source of water.

Reference: Letter from Elbert Dilley, a farmer of Route 2, Bentonia, Yazoo County, to the Extension Forester, giving Albert Russell's, a local negro farmer, directions for making charcoal the way he has done it for years past.

PART VIII

FOREST PROTECTION

PROTECTION FROM AND CONTROL OF FIRES [1]

LOSS AND INJURY CAUSED BY WOOD FIRES

Fire is an enemy of thrifty and profitable woods. The deep spongy layer of leaves, twigs, and humus covering the forest floor keeps soil cooler than the surrounding soil in summer and warmer in winter, conserves the moisture supply for the growing trees and for springs, and effectively checks soil erosion. According to the Mississippi Forest Service 3,700,000 acres of forest land have burned in the State each year for the past 5 years. This is about 22 percent of the forest area of Mississippi. These fires cause a tremendous loss in timber growth, litter, humus, and many other items, also loss in reproduction which keeps the stands constantly understocked. Everybody loses when timber burns—the owner, the community, and the Nation. The national loss is estimated at $20,000,000 annually. The longleaf pine is more resistant to fire than other species. However, fire retards diameter and height growth of longleaf seedlings about 20 percent. In sapling and pole-size trees, heavy defoliation results in one year's growth loss (normal height) being distributed over about 3 years, 60, 30, and 10 percent, respectively.

What fires do to the forest:

1. Forest fires kill tree seed and seedlings and thus destroy the future forest.
2. Forest fire injures saplings and trees and slows down their rate of growth.
3. Fire scars on tree trunks provide access to organisms to decay and insects that seriously injure or kill trees.
4. Fire destroys the mulch on the forest floor, thereby reducing the productivity of the soil.
5. With fire destroying the soil mulch, less rainfall is absorbed and trees are deprived of needed moisture; less water seeps down to maintain the flow of springs and streams and more of the rainfall flows off the ground surface.
6. Increased surface run-off of rainfall means soil erosion and rapid silting up of stream beds to cause destructive overflows of bottomlands. In other words, unburned forests protect soil, springs, wells, and streams, and guard against soil erosion and flood damage.

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[1] All references used in sub-section "Protection from the Control of Fires" are listed at end of same.

7. Forests provide ideal condition for wildlife. Burning the woods drives away useful birds and desirable animals, and the eroded material carried into streams, drives the best fish away.

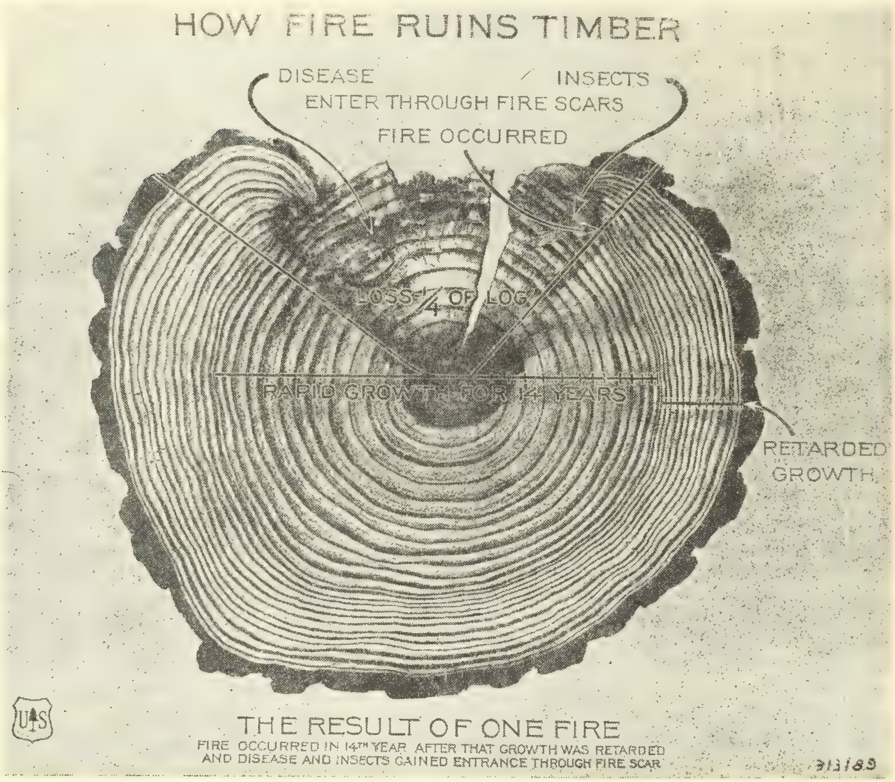
HOW FIRE RUINS TIMBER
DISEASE
INSECTS
ENTER THROUGH FIRE SCARS
FIRE OCCURRED
LOSS 1/4 OF LOG
RAPID GROWTH FOR 14 YEARS
RETARDED GROWTH
THE RESULT OF ONE FIRE
FIRE OCCURRED IN 14TH YEAR AFTER THAT GROWTH WAS RETARDED
AND DISEASE AND INSECTS GAINED ENTRANCE THROUGH FIRE SCAR
313183

FIGURE 36—A single light fire may kill the delicate cambium of living layer just beneath the inner bark, allowing fungi or wood-rotting disease to enter and greatly injure the value of the tree. This illustration shows the result of a fire that occurred in the tree's fourteenth year. After the fire, growth was retarded, and disease and insects gained entrance through the fire scar. U. S. Forest Service Photo.

Slash and loblolly pine seedlings are especially susceptible to fire, killing for the first 3 to 5 years of their life, and even a light burn during this period will kill most if not all of the young trees. With complete fire exclusion, however, and with simple management practices, the growth on sites, average or better, can be maintained at 1 to 1½ cords per acre per year; while without active fire protection, natural regeneration is slow and scattered, resulting in understocked stands with low volume-per-acre increments. With fire control and management, 25 to 40 cords per acre can be produced in 20 years, as contrasted with the usual 5 to 15 cord yield from unprotected, unmanaged stands of the same age.

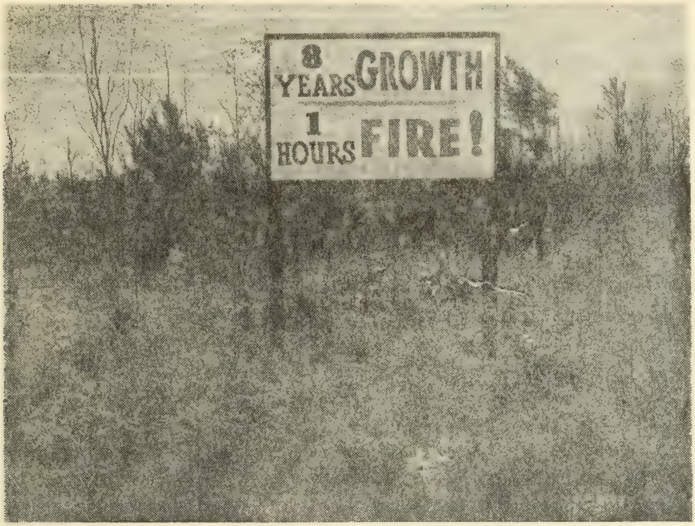

FIGURE 37—A single fire has completely destroyed 8 years' growth.

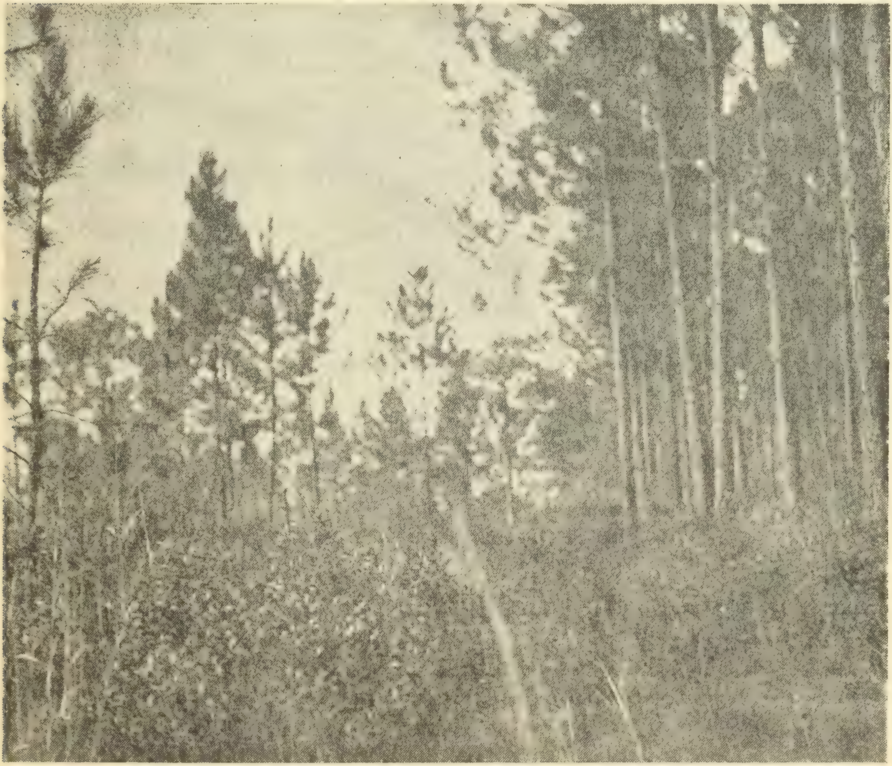

FIGURE 38—Slash pine stands in Greene County. Fire burned over the area on left annually for 9 years after it was excluded from area on right. Finally both areas were protected from fire and all of it seeded to pine. There still remains 9 years difference (lost) in age classes of the two stands.

CAUSES OF WOODS FIRES

Carelessness is usually the cause of woods fires. Often such fires occur when burning is being done to clean up tracts of new or old land, or they are set by smokers, who fail to extinguish matches and tobacco in cigars, cigarettes, and pipes. A few fires may be set maliciously, or, especially in the South, may be set by people who still think burning exterminate boll weevils, cattle ticks, and other insect enemies.

PREVENTION OF WOODS FIRES

Most woods fires on farms can be prevented if the proper attitude toward fire hazards is maintained by the landowner and the tenant. Farmers, by their efforts, can generally keep their woodlands from burning. They can stimulate and lead public sentiment against the heavy economic loss that occurs when timber burns.

Some useful precautions are the posting of fire-warning notices, maintaining a watchful lookout or patrol over the woodlands during dangerous fire periods, and maintaining firebreaks along dangerous boundary lines, and interior fire breaks connecting vital streams, highways, or roads. Plowed firebreaks serve to stop fire and in emergency of a serious fire serve as a base for backfiring—a hazardous but sometimes advisable action. Another method of preventing a fire is by plowing furrows several feet apart and burning the grass, etc., between the furrows as shown in the picture below.

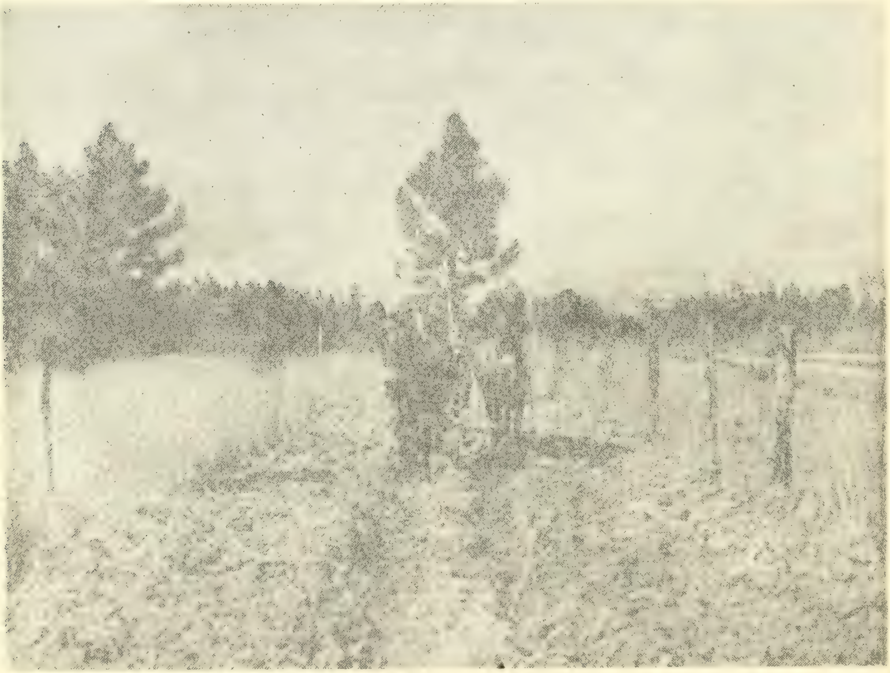

FIGURE 39—Firebreaks are necessary in large forest areas and are excellent protection against bad fires on smaller tracts. This firebreak in Alabama was constructed by plowing furrows and burning the dry sedge grass between them. U. S. Forest Service Photo.

REDUCING FIRE HAZARDS

Some of the more important fire hazards, or bad fire conditions which make fire likely to farm woodlands, and the protective measures that can be taken to reduce the danger of forest fires are the following:

Woodland fire hazards:	**Protective measures:**
1. Long dry spells when the entire forest area with its litter may be as dry as powder.	Neighboring farmers and communities should keep in constant watch for fires and help one another if fire starts. Keep out hunters and all others during such dry periods.
2. Large timbered areas unbroken by clean roads, creeks, and open fields.	Make fire lanes or breaks through and around the woods, and remove all timber from roads. Prescribed burning may be advisable under some conditions, but as prescribed burning is a technical job and dangerous, it should not be done without first discussing it with the forest fire warden. Every care must be taken to prevent excessive damage and escape of the fire to the lands of others. Talk over fire conditions with cattle grazers and others who use the woods and ask them to help in keeping out fire.
3. Heavy slash left on the ground after a logging job.	Lop off limbs, pull heavy tops away from standing trees, or when desirable burn slash during a damp period under direction of a local forester. When harvesting trees, cut low stumps to get more timber and to reduce fire danger.
4. Stands of dead timber or groups of trees killed by fire or insects.	Remove and use recently killed timber and treat the tops and brush as in 3.
5. Idle land grown up with weeds, dry sedge, and other grasses.	If the land can be used for crops or pasture, improve and use it; if it is low-grade land, plant to trees. Seedling trees can be purchased from the State Forestry Department.
6. Roadside slash and brush left by clearing.	Report to local or State highway officials or to the local forest ranger. Take care that warning fires do not escape.
7. Heavy windfalls and snags.	Use windfalls if timber has value; otherwise clean up fallen trees, scatter brush, and burn during a damp period. Cut all snags near firebreak or road as they may fall across the fire lane or cause sparks which may spread the fire.
8. Dead weeds, grass, and brush bordering farm building and other fire hazards around farm.	Clean up such fire hazards around the home, barn and other buildings. Keep weeds cut, clean up brush and rubbish, and use the grass if possible. Sedge or brush burning should be done only during damp periods of low fire risk and after 5 o'clock in the evening.
9. Waste materials and open fires around town and village dumps that border woodlands.	Report such conditions to the town or village officials and to local representatives of the State Forestry Department.

Woodland fire hazards: (continued)	**Protective measures: (continued)**
10. Trash, sawdust piles, abandoned buildings, etc., around mill sites.	If possible, reduce fire danger by cleaning up trash, plow fire lines around the mill site, and keep close watch for fires. If mill is operating, warn the workers of the danger of fires escaping into the woods.
11. Waste materials and other trash around camp and picnic grounds near forest areas.	Post fire-prevention and keep-clean signs. Visit areas frequently, make fire lines, and in bad dry spells, close the areas to visitors.

ORGANIZED WOODS OR FOREST-FIRE PROTECTION

The State Department of Forestry maintains efficient forest-fire organizations whereby they aid woodland owners in fire prevention and suppression. The protection work is carried on in cooperation with the Forest Service, United States Department of Agriculture, under provisions of Section 2 of the Clarke-McNary Forestry Act. At the present time, the forest landowner himself pays 2 cents per acre (usually with counties as local units, and fire wardens, rangers, and towermen are employed.) Thousands of farmers participate in these close-knit organizations as volunteer firefighters for forest protection at a small cost. The one objective of such cooperative mutual aid is to prevent fires, and if they do occur, to stop them as quickly as possible. The fire tower is used by the Department of Forestry in locating outbreaks of fires.

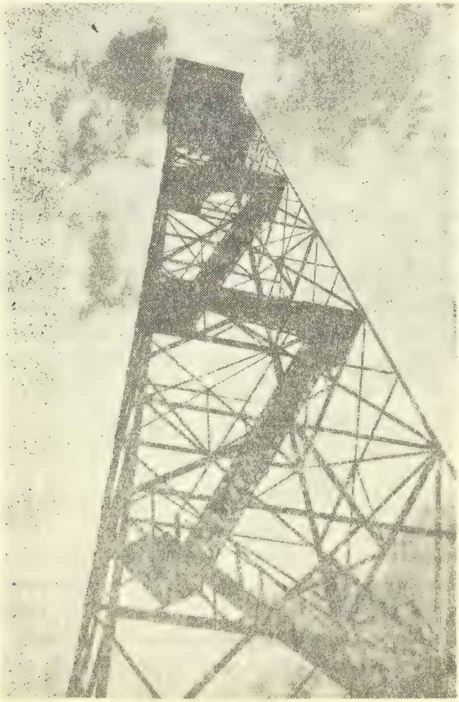

FIGURE 40—One of the fire towers used by the State Forestry Department in detecting forest fires.

COMMUNITY FIRE PROTECTION

Two types of safeguards have already been set forth: (1) the elimination, so far as possible, of needless fire danger; and (2) individual or home preparedness for extinguishing fires before they reach serious proportions. The third type of safeguard is community fire protection.

To bring out more clearly the relation of the third and final fire safeguard, community fire protection, to the other two, let it be assumed that in a certain farm community the suggestions already given have been adopted and followed in a practical way. In other words, let it be assumed that in this community all farmers give reasonable attention to the elimination of fire hazards in the construction and maintenance of their buildings, and exercise reasonable care in the selection and handling of equipment and material used in connection with household fires, and in the prevention of fire in their woodlands; also that each farm in this community is supplied with certain simple fire-fighting equipment which is readily at hand in designated places and with which a fire can be promptly reached and extinguished before it has attained seriously destructive proportions.

In such a farm community the average fire loss will be small. Accidental fires will occur only rarely, and of those that do occur, a substantial percentage will be extinguished before the loss is serious. However, it is reasonably certain that even in such a community some fires will occur, and that occasionally one of these fires will not be discovered until it is beyond control by means of any ordinary home fire-protection equipment. In such cases, an individual needs help in putting out the fire, or at least in keeping it from spreading to other buildings, property, or woods.

The need for such organized protection is more pronounced in the more typical farm community in which fire prevention and home fire-fighting equipment are given only meager attention.

A rural fire department may not be able in many cases to save the building in which fire breaks out, particularly if this building happens to be the barn. But in most cases, it will prevent the fire from destroying other property on the place and will thereby substantially lessen the loss that otherwise would occur.

FIGHTING WOODS FIRES

In view of the fact that in spite of all the precautions farmers may use, some woods fires will occur and every farmer should have certain fire fighting equipment to extinguish such fires as quickly as possible.

FIRE FIGHTING EQUIPMENT

The average farmer possesses the necessary equipment to extinguish fires, especially in the early stages of woods fires. A suggested list of equipment with a discussion of each is shown below:

1. *Portable pump.* A 5-gallon tank strapped to the back, with a pump operated by hand, is capable of projecting water 25 to 30 feet.

2. *Swatters.* A common method of direct attack on surface fires is to beat them out with swatters. The best swatter for the purpose is a broad rubber flap attached to a handle. The long-employed pine brush or wet burlap ("crocus") sacks can be used as substitutes.

3. *Rakes.* It is often unnecessary to wait for a fire to reach a firebreak before attacking. It can be stopped by making a temporary firebreak nearer the fire. This can be done by raking a strip 4 or 5 feet wide to clear away all combustible matters, such as pine needles and leaves.

   The best tool for this purpose is a rake of the saw-tooth, or mowing-blade type, rather than a rake with slender tines. This can be made from an old mowing blade.

4. *Hoes.* Where there is grass and weeds, the hoe is useful, but progress is slower than where rakes are used.

5. *Shovels.* Shovels are useful in dealing with ground fires to dig trenches and to smother smoldering fires with dirt.

6. *Mattocks and grub hoes.* These are especially needed in digging trenches to control ground fires where the ground is too hard to shovel.

7. *Axes.* For removing snags that are likely to burn and spread live embers under the force of the wind, and for cutting out logs or fallen timber that obstruct the progress of the fire truck axes and crosscut saws are important.

8. *Bush hook.* A bush hook is often useful in clearing out passage ways and in removing palmettos, gallberry and other bushes that are capable of burning.

9. *Plow.* A temporary firebreak to arrest a fire can be quickly plowed in the more open areas of the forest.

10. *Drags.* A strongly constructed drag, slanted to push debris to the side opposite the fire, can be used effectively on fairly open, level areas of the forest, but they are not likely to be widely adapted because of obstructions they will meet and the injury they will do to seedlings.

11. *Barrels and buckets.* A constant supply of water is essential. Preparation should be made to carry water in barrels by truck from the nearest stream and supply it to portable pumps by buckets.

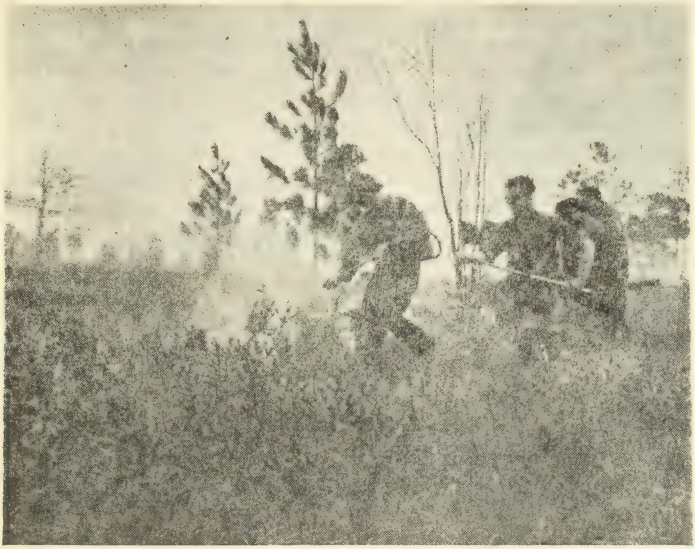

FIGURE 41—The use of different items of equipment in fighting forest fires.

MOPPING-UP

Fire in the forest is not completely subdued until completely eradicated. Where there is smoke, there is smoldering fire. One of the most dangerous remnants of a fire is in dead tree snags and stumps, especially pine snags and stumps which can harbor a smoldering fire for several days only to be fanned into flames and to scatter burning embers in a wind to start another fire. This is why it is recommended that all dead snags be cut down along firebreaks as a fire control measure.

Fires smolder in the duff or humus accumulated in depressions or holes in the forest floor. Mopping up these fires is important when near a firebreak or the edge of a suppressed fire. This can be done with water or with covering of soil.

The "moppers-up" should patrol the rim of the fire for 12 hours or more after the fire has been suppressed to see that smoldering fires start no new flames.

POINTERS IN FIGHTING FIRES

To prevent and control forest fires in a farming community, keep a careful watch for fire or smoke, get to the fire quickly, and stop it before it covers much ground. Neighbors can help each other by watching for fires in woods not easily seen by the owners. School children, timber haulers, rural mail carriers, salesmen, and others using the highways, can be of real service to the community when they see a fire if they notify the nearest farmer and nearest forest ranger. Often times, a fire just getting started can be stopped on the spot. Remember that the easiest way to control fire is to discover it quickly and extinguish it while it is still small.

Other pointers in fighting fires are:

1. Be alert during all dry spells and fire seasons.
2. Try to locate the fire accurately, and notify the fire warden in your area by telephone. If you have no warden call neighbors for help and go immediately to the fire. If the fire is on a neighbor's land, notify him immediately and help him to extinguish it just the same as you would help him extinguish a fire in his house or barn.
3. Be prepared by having fire fighting equipment listed above. A team of mules and a plow may also be helpful in making fire lanes.
4. Size up the fire and plan the attack so as to use your help to best advantage in fighting the fire.
5. When possible fight the fire at its head (place where it is burning hardest and fastest).
   - A. Pinch off the head of a fire or fight it directly if it is not burning too hard.
   - B. Beat out fire or make fire lane along sides and rear.
   - C. Take advantage of woods roads, trails, firebreaks, etc.
   - D. Watch fire lane, snags, roots, etc., closely, to keep the fire from breaking over.
   - E. Be sure the fire is entirely out before leaving it.
6. Backfire to bring fire under control.
   - A. Use this method only when fire is too large and moving too rapidly to fight directly. Carefully plan the backfiring and keep it to the smallest possible area to avoid unnesessary damage and to prevent fire from burning the property of neighbors.
   - B. Use roads, firebreaks, and natural barriers from which to backfire.
   - C. Make sure the backfiring lane is free of trash and wide enough to keep the backfire from crossing it; proceed slowly and with caution.
   - D. Keep a sharp eye on the backfiring lane so that if the fire crosses the land it can be quickly whipped out.
7. Patrol the fire lanes until all flames and sparks are out.
8. Try to determine who or what started the fire.
9. Estimate the acreage covered by the fire and the damage done to merchantable timber and young growth.
10. Report the facts about the fire to your local fire warden.

References: (1) Leaflet "Pulpwood and Forest Fires," by J. G. Osborne, associate Silviculturist, Sourthern Forest Experiment Station, Reprint from the "Paper Industry Journal," September, 1937. (2) Handbook "Forest Fire Fighting," Division of Forestry, Department of Natural Resources, pp. 4, 5, 9, 10, 11, 12, and 13, Atlanta, Georgia, October, 1942. (3) United States Department of Agriculture Bulletin No. 1643, "Fire Safeguard for the Farm," pp. 19, 20, 23, Washington, D. C., December, 1939. (4) United States Department of Agriculture Bulletin No. 1926, "Preventing Destructive Fires in Southern Woodlands," pp. 1, 2, 3, 9, 10, 11, 12, 13, and 14, Washington, D. C. (5) 1945 Annual Report, "What the Forest and Forest Industries Mean to Mississippi," Mississippi State Forest Service, page 8, Jackson, Mississippi, 1945. (6) "Longleaf Pines," Book by W. G. Wahlenberg, published by Charles Lathrop Pack Forestry Foundation, page 146, Washington, D. C., (in cooperation with the United States Department of Agriculture Forestry Service) January, 1946.

PROTECTION OF FOREST FROM CATTLE GRAZING

Grazing Cattle on Longleaf Pine Forests

The opportunities of cattle grazing in rounding out forestry operations have long attracted owners of southern pineland. Some land owners graze cattle to consume grass and thus reduce the forest fire hazard. Others, especially when open range grazing prevails, look with favor upon cattle under fence as an aid to more complete control of their own land, affording better production from trespass and uncontrolled fires. Still others are interested in making full use of all the land resources, including a fair financial return from the grass-cattle combination so as to pay land taxes or other maintenance costs, particularly on clear-cut land or other areas where there is an expensive lag in harvesting merchantable timber.

In Mississippi there are evidences at present of increased interest in livestock grazing; namely, (1) an all-time high in cattle numbers, (2) better-quality herds, and (3) more adequate care and feed provided. But forest landowners, whether with or without cattle, face urgent problems in coordinating cattle grazing with timber production. Some questions asked are: What are the real values and limitations of grazing to the forest enterprise? What special provisions are necessary in handling the cattle and in keeping the herd fully productive? These and other considerations are gradually becoming clearer as a result of special studies of forest grazing in the South. The Southern Forest Experiment Station, in cooperation with the Louisiana Agricultural Experiment Station, recently completed a study,* based on interviews with 118 farmers who graze cattle on forest range at some time during the year. The results, along with information from experiments in other parts of the South, should be of interest, and should help answer some of the questions about woods grazing.

Trees of first importance. Questions invariably arise when cattle grazing on forest land is mentioned, because trees are the primary crop. How about possible grazing damage to trees? What is the actual reduction in fire hazard? Does prescribed woods burning fit in, and if so, how? The answers to some of these questions are clear-cut, but most need further study for a satisfactory solution.

Damage to pine seedlings. The Louisiana farmers interviewed reported that when ranges are moderately stocked, cattle do little damage to pine seedlings. They may graze some hardwood seedlings, especially during the spring, when buds are tender and growing.

Grazing reduces forest fire haard. The Louisiana farmers reported that cattle grazing reduces the fire hazard an average of 27 percent. Estimates in other parts of the South are higher, averaging as high as 60 percent. During the spring of 1944 cattle utilized over 40 percent of the new green growth of a broomsedge type in one pasture on the Kisatchie National Forest in Louisiana. Furthermore, close grazing encourages the spread of such low-growing plants as carpet grass, Dallis grass, and lespedeza and brings about a corresponding reduction in the growth of large coarse grasses as broomsedges and wire-grass, which form the highly inflammable rough on many forest ranges. The invading plants, being better forage, are closely cropped and, consequently, present a negligible fire hazard in contrast to the usual lightly grazed or ungrazed rough. Thus, on grazed ranges, accidental fires usually do much less damage than on ungrazed areas.

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*Campbell, Robert S., and Rhodes, Robert R. Forest grazing in relation to beef cattle production in Louisiana. Louisiana Agricultural Experiment Station Bulletin 380, 43 pages, illustrated, June, 1944.

Burning. Interviews with farmers in North Carolina, Georgia, and Louisiana, disclosed almost unanimous opinion that indiscriminate fires damage both the trees and the forage. Stockmen who oppose uncontrolled burning feel that it thins the stand of forage, may lead to serious erosion, and actually removes plant material needed by cattle.

Some foresters in the longleaf pine belt practice carefully prescribed burning to reduce the rough and to remove excess fire hazard. This fits in very well with grazing management in that type. In a cooperative study at Tifton, Georgia, the Appalachian Forest Experiment Station found that the forage on burned wiregrass range made earlier growth, was more nutritious and palatable, yield was slightly higher, and cattle made better weight gains than on unburned range. Very similar results were reported for the well-known McNeil, Mississippi, study. On the other hand, experiments in the reed or switch cane forage type in North Carolina indicated that fire is not desirable as far as grazing is concerned, since it reduces the grazing capacity and shortens the season.

Prescribed burning is not recommended outside the longleaf pine type of forest .

Many farmers grazing cattle on forest range operate on the basis of keeping costs to a minimum in the belief that better feeding may not pay off, at the same time recognizing that improved practices will increase calf crops and beef production. However, studies in the South have indicated definite increases in net operating returns per farm in proportion to increases in calf crop.

Many farmers graze cattle on forest range throughout the year, where there is a desirable combination of pine forest for spring and summer grazing with bottomland hardwood for winter. However, chemical analysis in nearly every state from North Carolina to Texas show the native forage to be deficient in certain essential nutrients during much of the year. Protein, phosphorus, calcium, and other essential minerals are inadequate to maintain even dry cows, and far below that needed by cows nursing calves and by growing animals. (See Georgia Coastal Plain Experiment Station Bulletin 27, 1943.) Consequently, cattle owners depending on forest range should consider ways in which their herds can be provided better year-long nutrition. An improved season of forest grazing is one way to attain immediate betterment in cattle production. Depending upon the individual set-up, seasonally grazed forest range can be complimented by other sources of forage such as improved pastures, farm-raised forage and feeds, (including both hay and concentrates), winter cover crops, and supplemental feeds.

As to supplemental feeding, the common practice is to feed cattle a concentrate such as cottonseed meal, frequently with hulls, throughout the worst winter months, usually from January to March, inclusive, although the average ration now is a subsistence rather than an adequate maintenance ration. Based on research already done, it appears that minerals and concentrated protein feeds as supplements to range should go far to attain better forage utilization; reduce death losses; increase the calf crop, the weight, condition, and market value of calves at selling time; and step up the rate of growth and development in young animals. Costs would be substantially less than the increased returns.

The use of forest range should thus be fitted into the season when it can be grazed most effectively. There are three main types of operation:

(1) Year-long forest range grazing with supplemental feeding as needed during the winter to keep herds alive. Individuals with this type of operation in Louisiana study averaged 35 to 40 percent calf crop, calves weighing 250 to 275 pounds at weaning age, and death losses 5 to 10 percent. There were outstanding exceptions with much higher production, where adequate supplemental feed was furnished in winter.

(2) Long-season forest grazing from spring through summer and fall, with grazing on farm pastures or cover crops and necessary supplemental feeding during winter. This type of operation was more productive as animals usually were in at least fair condition year-long.

(3) Short-season forest range grazing commonly in spring and early summer, with cattle on other kinds of forage for the balance of the year, i. e., on farm pastures, field aftermath, cover crops, and adequate supplemental feed in winter. This type of operation in the Louisiana study averaged 70 to 80 percent calf crops, calves weighing 350 pounds or more, and with death losses around 2 percent or less.

Grazing on managed forest land. Good forest management makes more problems for the grazer. Ample palatable grasses will grow on clear-cut or partially restocked land, but profitable grazing management under a fully stocked forest is a different matter. This is due to the gradual lessening in amount and perhaps quality of forage, following shading-out by trees. Farmers interviewed in the Louisiana grazing survey estimated an average reduction of 2.5 percent per year in grazing capacity as the canopy of a fully stocked stand closed over. However, there will always be openings in any well-managed forest, occurring both naturally and through cuttings. Also, wide fire lanes, both of which if seeded to improve pasture grasses, can be maintained to furnish a continuous base on which to carry the herd.

Reference: Leaflet "Grazing Cattle on Southern Pine Forests," Southern Forest Experiment Station, New Orleans, Louisiana. Reprinted from "Southern Lumberman," December 15, 1944.

Cattle Grazing in Loblolly-Shortleaf Pine and Hardwood Forest

The grazing discussion thus far is applicable only to the southern or longleaf pine area of Mississippi. Grazing of woodlands in the loblolly-shortleaf, hardwood and both bottomland and upland hardwood forest types in the rest of the State is an entirely different situation.

GRAZING HARDWOODS

Studies made at the Purdue Experiment Station, Lafayette, Indiana, on effects of grazing in hardwood forests show that the exclusion of livestock is the first step in the management of farmwoods. Without such protection natural regeneration is impossible and a gradual transition through successive stages from woodland to pasture takes place. This and other studies show that livestock damage the roots in many cases, also the bodies and branches of small trees.

Trampling of the soil decreases water absorption, also makes conditions less favorable for reproduction. Overgrazing is believed to cause an increase in butt decay.

Studies on browsing of trees by the Forest Service show that the foliage of a number of the more valuable hardwood species is particularly palatable to livestock, while less valuable species are less palatable. This means that continuous grazing of hardwood timber encourages the growth of poorer species while the species of young seedlings of the better species disappear and eventually the forest is one of poor or less valuable species.

References: (1) Indiana Agricultural Experiment Station Bulletin No. 431, "The Development of Natural Reproduction in Previously Grazed Farmwoods," page 2, Lafayette, Indiana, July, 1938. (2) United States Department of Agriculture Leaflet No. 86, "Protect Hardwood Stands From Grazing," Washington D. C., Revised 1941.

GRAZING LOBLOLLY PINE

A test was started in October, 1938, on the Crossett Experimental Forest in Arkansas to discover what effect modification of the natural seedbed had upon the germination, initial growth, and survival of loblolly pine seedlings on cut-over old-field areas. The experiment consisted of six overstory (upper crown cover) conditions and three seedbed treatments on both grazed and ungrazed plots. (That is, 36 combinations of factors (6 x 3 x 2) were tested.)

Half of the plots were fenced in to prevent grazing. The unfenced areas were subject to free range grazing, which was somewhat heavier on the thinned plots than in the adjoining woods, owing to a greater abundance of forage in the more open spaces brought about by the cuttings.

Seedbed or surface conditions tested were (1) cultivated soil, (2) mineral soil bared by raking away litter, and (3) unaltered soil covered with pine straw, hardwood leaves, and occasionally a pine top or other logging debris. The cultivated surface was moderately rough, no attempt being made to break up clods in the process of turning under litter and surface soil. This surface was subjected to considerable washing and settling in subsequent rains, which had a tendency to cover seeds with soil during the first few weeks after sowing. Raking exposed from 75 to 95 percent of the surface mineral soil, leaving the remainder occupied by grasses, shrubs, and other firmly fixed vegetation. The cover on the check plots consisted of litter varying in depth from 0.1 to 1.0 inch, some logging debris, and vegetation conditions similar to those on the raked plots.

Immediately after surface treatment, 170 loblolly seed (30 percent germinative capacity) were sown broadcast on each plot. Seedlings resulted from this sowing were counted and marked in April and May, 1939, and this value was used as the total germination count. In February, 1940, the seedlings were again examined and height measurements made of all survivors.

The results of this test are summarized as follows:

(1) Little more than half as many loblolly pine seed germinated on the grazed plots as on the ungrazed plots, however, some of the damage might have been caused by predators such as birds and mice. Subsequent mortality indicates that grazing during the first growing season following germination was of little consequence.

(2) The influence of overstory [1] is not clear, maximum germination having occurred under the most dense and the least dense lolbolly stands. Stands of intermediate density provided neither effective protection nor the best germinating conditions. The mortality during the growing season would indicate that seedlings under dense overstories found it more difficult to survive than those in comparatively open situations.

(3) Loosening mineral soil through cultivation, or exposing the surface by raking, materially increased the number of germinating seeds. Cultivation increased seedling survival over that in either a raked or an untreated seedbed. At the end of the first growing season the number of loblolly seedlings in the cultivated beds was definitely greater than that in the raked seedbeds, and the latter in turn was greater than the number on undistributed surfaces.

(4) Cultivation under overstories of either dense or very open stands gave the most seedlings during the first year.

(5) The variable factors studied had no manifest effect on height growth in the first growing season.

(6) The results of this study indicate that in managing a forest of loblolly pine during a period of regeneration, reproduction can be increased by:

   A. Partially exposing the mineral soil before seedfall by cultivation or raking, or possibly by logging, or perhaps in rare cases by burning.

   B. Not permitting grazing during the winter and spring following a seedfall.

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[1] Portion of trees in a forest forming the upper crown.

Reference: Leaflet "Loblolly Pine Establishment as Affected by Grazing, Overstory, and Seedbed Preparation," Vol. 39, No. 5, United States Forest Service. Reprint from Journal of Forestry, May, 1941.

DAMAGE FROM GRAZING HOGS IN THE LONGLEAF PINE AREA [1]

The damage inflicted upon longleaf pine regeneration by hogs on woods range is very great. Hogs root up the seedlings and often return to the spot annually to consume those missed earlier until in perhaps 3 to 5 years after seed germination, there are few or none left. Such damage often exceeds that of fires in certain areas.

Hogs are attracted to the main taproot. Lateral roots of seedlings are rarely touched. However, large laterals of saplings are more attractive to hogs than small roots. Occasionally, hogs dig trenches reaching 35 feet to get to the roots. The inner bark is especially attractive, more in the spring when other food such as oak mast is scarce or when high waters have driven the animals from hardwood bottoms and swamps; and since the surface soil in the piney woods is soft, it is easy for seedlings to be readily uprooted.

Hog damage is usually concentrated near rural settlements and on the less well-drained longleaf soils. In such areas, hogs have been observed to kill 8,320 two-year-old longleaf pine seedlings per acre at rates estimated at from 200 to 400 per day. This rate was doubled or tripled over short periods where the stand was readily accessible and rooting easy. Thus, one hog might destroy an acre of planted pines in one day. In another case, hogs were observed to kill about 60 percent of a well-stocked stand of longleaf pine in the grass stage over a period of several months. In this instance 10 percent of the surviving seedlings were damaged.

An open-range survey on the DeSoto National Forest in Mississippi revealed that hogs attacked nearly one-third of the longleaf pine saplings 2 to 8 inches in diameter but did relatively little damage. Greater harm was done to saplings 5 to 15 feet high. Most seriously injured were the seedlings between 2 and 48 inches high; among these, from 9 to 44 percent were attacked in different districts.

Consumption of seeds by hogs is usually far less serious than injury to seedlings. However, hogs sometimes devour longleaf pine seeds almost as soon as they fall, leaving only a few to germinate. A study[2] of such damage in unprepared seed spots in southern Mississippi disclosed that in 10 nights 1 old sow with 6 pigs removed 3,454 seeds out of 12,000 available. Of those taken, 61 percent were from the burned and 39 percent from the unburned portion of the area.

[1] "Longleaf Pine" by W. G. Wahlanberg, published by Charles Lathrop Pack Forestry Foundation, pp. 178-179, in cooperation with the United States Department of Agriculture, Forest Service, January, 1946.

[2] Watkins, Allan G. "Destruction of longleaf pine seeds by mammals at the Harrison Experiment Forest, Mississippi, 1935." U. S. Forest Service, Southern Forest Experiment Station. (Unpublished).

DAMAGE TO LONGLEAF PINE BY GRAZING OF SHEEP AND GOATS[1]

Sheep and goats, unlike hogs, do not usually damage longleaf seedlings until the pointed bud is formed. These animals browse and nip buds from the terminal shoot of larger seedlings. Above 3 or 4 feet the buds are again relatively safe, but occasionally, a sheep or goat may bend down saplings to get at their buds. The smaller seedlings in the grass stage are likewise relatively safe, the damage from trampling being negligible except in long-established bedding sites. Indirect harm to the pines, however, results from compaction of the soil.

Sheep may attack longleaf pines at any season of the year if the buds are 0.4 inches or more in length. About three-fourths of the buds are removed from October to April. Little reduction in height results from removal of a single terminal bud from a thrifty pine, because during active growth it is promptly replaced by an adventious bud, which is a bud that appears where it normally would not be found. Both natural and substitute terminal buds, however, may be broken off repeatedly on areas heavily stocked with sheep[2]. Many of the broken buds may not be succeeded by dual leaders, and crooks in stems grown from side buds are slight. Hence, in time, early stem deformity will be completely obliterated.

Sheep damage to longleaf pine has been studied on the Leaf River district of the DeSoto National Forest, Mississippi. One sheep to each 12 acres was admitted to a range of 1,300 acres of regeneration, with all other stock excluded. Within the tract the sheep had access to seedlings 2 to 48 inches tall but were excluded from seedlings on small, fenced sample plots. In 2 years, 83 percent of the unprotected seedlings were injured by removal of terminal buds. Mortality from disease and grazing amounted to 2.3 percent in the ungrazed sample plots, and 4.6 percent in the area grazed by sheep. Seedlings up to 40 inches high were most affected, the damage being greatest in the smaller or medium-size classes. The loss in height growth in 2 years averaged about 20 percent; for trees from 10 to 24 inches tall, it was 40 percent. These tests showed that sheep should be excluded from longleaf regeneration areas until the land is reasonably well stocked with seedlings 40 inches or more in height.

A more extensive survey of grazing damage covering 23,640 acres of longleaf pine open range on the Leaf River district showed the following results: Of 3,485 longleaf seedlings examined, the proportion multilated by sheep ranged from 4 percent on one grazing unit to 92 percent on another, averaging 56 percent. An average of 47 acres of range was available to each animal. Of the 705 saplings 5 to 15 feet high on sample areas, 28 percent bore substantial marks of earlier injury by sheep. Among 445 dead seedlings (2 to 28 inches high), fire and sheep together destroyed 58 percent, hogs 31 percent, rust canker 6 percent, brown spot 4 percent, and mechanical agents 1 percent.

[1] Taken from "Longleaf Pine" by W. G. Wahlenberg, published by Charles Lathrop Pack Forestry Foundation, Washington, D. C., pp. 179-180, in cooperation with the Forest Service, U. S. Department of Agriculture, January, 1946.

[2] Gerhart, George A. Initial report on livestock damage to pine reproduction on the open range of the DeSoto National Forest. 1941 U. S. Forest Service, Region 8, Atlanta, Georgia. (Unpublished).

INSECTS AND DISEASES

Insects and diseases do some damage in Mississippi forests each year, however, it has not proven practical to apply control measures in very many cases. On the other hand, preventative measures should be practiced. Therefore, the discussion below is directed mainly in that direction.

INSECTS [1]

Controlling the most important forest insects. A number of species of insects attack forest trees. Some of these attack the leaves, but the most destructive insects feed on the cambium layer and rear their young between the bark and the wood. Most of them normally attack dying forest trees and recently felled timber. When present in unusually large numbers a few of these species may infest and kill healthy trees or those only slightly injured from other causes.

The only pine-feeding species that can be controlled without felling infested trees is the black turpentine beetle. These beetles attack pine trees near the ground, each pair making a short burrow lengthwise of the trunk under the bark. Eggs are placed in this burrow and, after hatching, the young, feeding on the cambium layer, enlarge this burrow into a cavity, sometimes extending over several square feet. The presence of the insects under the bark is indicated by pitch tubes extending outward from openings in the bark. There may be one pitch tube for each colony of insects. These insects can be removed by cutting the bark around the edges of the cavity with a chisel. Spraying the wound with kerosene will kill any that might be mature enough to survive outside the cavity. The black turpentine beetle seldom if ever kills trees but causes cat faces on them and affords means of entrance of more destructive species.

Two beetles belonging to the genus Ips [2] and the southern pine sawyer normally feed under the bark of dying pine trees and recently felled timber. Where pine sawlogs are left too long in the forest or the slash is not properly disposed of, a large number of beetles may be produced that will attack and kill healthy trees and those only slightly injured from other causes. The Ips beetles attack the trunk, usually above 10 feet high, and the larger limbs. They make pitch tubes at the entrance of their burrows in large limbs. They also make pitch tubes at the entrance of their burrows in living trees. The burrows of this species also extend lengthwise of the trunk. Eggs are placed in niches in the side of these burrows and when hatched make burrows at right angles to the burrow made by adults. A number of broods may infest a tree and completely girdle and kill it.

The southern pine sawyer also feeds between the bark and the wood and under some conditions may attack living trees and kill them by destroying all the cambium layer beneath the bark.

The hardwoods are also subject to attack by a number of species of bark-beetles under certain conditions. The two most destructive species are the shot-hole borer, which also attacks fruit trees, and the hickory bark beetle. The shot-hole borers are usually found in rather large numbers but seldom kill trees unless they have been injured previously from other causes. They usually breed in drying branches or recently cut trees, and if dead wood is not kept out of forests these beetles may be produced in numbers large enough to attack living trees and kill those that are weakest. The hickory bark beetle feeds under the bark of dying hickory trees and is capable of attacking and killing healthy trees when large numbers of adults are present.

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[1] By Dr. Clay Lyle, State Entomologist, and Mr. J. M. Langston, Entomologist, State Plant Board, State College, Mississippi.

[2] Ips callifraphus and I. grandicollis.

The only control measures known for insects that feed between the bark and the wood of trees is to fell infested trees and utilize the usable parts, or remove the bark from them and the stumps, and burn the bark and the slash. Pine logs can be floated in water until they are used, while hickory and possibly other hardwoods can be submerged in water.

Controlling insects in forests after trees become infested may require the sacrifice of valuable timber. If the insects are not controlled, the loss is still greater. The least expensive control measures are those applied to prevent insect damage. The best control can be obtained by practices that will reduce to a minimum the numbers of insects produced. For this purpose all timber that is cut during the summer should be used or treated within a month to prevent insect breeding, and that cut during the winter should be disposed of by March 15. All unusable parts should be burned, including the bark of the stump. Logs that will float can be placed in deep water and those that do not can be submerged in shallow water until they are used. If logs are to be left in the forest for some time the bark should be removed.

The logs may be subject to attack by another class of insects called ambrosia beetles, which cause pin holes in lumber. Branches with bark on them should be used for fuel during the winter provided it is all used by March 15 or placed where any beetles that emerge will not be able to infest other timber.

The sometimes recommended practice of cutting trees in small numbers at different times of the year and leaving the tops on the ground so that each new brood of insects that emerges will find worthless material ready for attack may prevent serious damage in some cases. However, the hazard is there as long as any material capable of being infested is left on the ground. The practice of cutting all the usable timber on a piece of woodland in the summer and leaving the tops on the ground, often results in nearby timber being seriously injured by beetles.

There are a few insects that feed on the leaves of forest trees and sometimes defoliate them. The young of a species of sawfly sometimes attacks pine trees and in some cases may defoliate numbers of trees. The forest tent caterpillar has attracted much attention in southeast Mississippi during recent years by its defoliation of sweet gums and some other trees over many thousands of acres. Defoliated trees may not be killed but they are injured and may be made more susceptible to attacks by bark beetles. Where forest trees used for ornamental purposes become infested they may be dusted or sprayed with poisons.

The pine tip moth is also occasionally injurious to pine trees but under forest conditions it is hardly practical to attempt control.

Specimens of any insects attacking forest trees should be sent to the Entomologist at State College for identification and recommendations for control.

DISEASES 1/

Tree diseases take a heavy toll each year from forests and farm woodlands. Much of this loss is preventable if attention is given to timber defects and the factors which lead to them. Some diseases kill trees outright, but the major loss results from those that cause standing timber to rot or otherwise become defective. Trees that are rotting faster than they put on new wood will never produce a product of value; hence they should be removed from the woodland.

Trees are susceptible to disease from the seedling stage to maturity and the grower should be constantly on the alert for "sick" trees so that they may be removed or treated. When a "sick" tree is found, it is a good practice to send a specimen of the tree to the Forestry Department at the State Experiment Station, State College, Mississippi.

In operating a woodland, it is a good practice to cut out defective trees and salvage any salable portion during the regular logging operation. Sometimes a defective tree may be considered as "not worth cutting," so it is left standing. Such trees take up room and furnish inoculum which may infect the adjacent healthy trees. Logs should be removed as quickly as possible after they are cut. If cut logs are left lying on the woodlot for any appreciable time, wood rots and wood stains develop which reduce the value of the logs. In addition to the loss from wood rots and stains, there is also considerable danger of loss from fire. With careful logging practices and fire controls, a woodlot should increase in value each year.

According to Dr. Paul V. Siggers, Bureau of Plant Industry, Saucier, Mississippi, there is only one forest tree disease of economic importance in Mississippi in which the control is simple and economical to the extent that it might be used by farmers. Dr. Siggers says: "This disease is the brown spot needle blight, of economic importance in parts of 12 or 13 counties grouped in the southeastern corner of Mississippi, i. e., in areas where longleaf pine is the major forest type. This disease occurs on the foliage of many southern pines but does not, in nature, affect the growth of any species of pine, except longleaf and on this host it is serious only in the seedling stage."

1/ The section of "Diseases" was written from articles and letters by Dr. J. T. Presley, Plant Pathologist, State Plant Board, State College, Mississippi, and Dr. Paul V. Siggers, Associate Pathologist, Bureau of Plant Industry, Saucier, Mississippi.

"Prescribed burning," which is where fire is used only for certain recognized purposes and on lands where these uses are valid, will control the brown spot needle blight. When a ground fire passes through a stand of infected longleaf seedlings in winter the mass of diseased needles is destroyed. The reduction in amount of the disease permits seedlings to retain their needles for the second growing season, thus furnishing the stimulus for vigorous growth in height."

Prescribed burning involves the technique of handling fire. Therefore, for farmers attempting to use this control measure, it might be well to contact their area Forest Ranger and arrange for assistance in the application of this measure.

BULLETIN 433 MAY 1946

Some Factors Related To Food Preparation

By

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Some Factors Related to Food Preparation

By DOROTHY DICKINS
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It is the purpose of this report to examine some of the factors probably related to family food preparation—factors such as family composition, schooling, and food and nutrition information of homemaker, economic status of family, family background of homemaker and male head, time expenditures in food preparation, scheduling of homemaker, type of menus served, equipment for food preparation, and arrangement of this equipment. It is important to learn more about these factors and how they are related to food preparation, for it is on the basis of such information that practical suggestions for improving preparation can be formulated. Better food preparation is one way of raising the level of living of a family. The food supply one has can be made more adequate by following the methods of preparation that conserve nutrients. A more adequate food supply will result in better health and better health in higher levels of living.

Scope of Study

This is part of a large study of food preparation of small town families of Mississippi. It includes 160 of the 1,158 families in the larger study,[1] selected so that there were 16 or more families in each of eight groups: white families in the Delta and Shortleaf Pine Area towns with housing values of $20.00 and under, and of $20.01 to $40.00; and Negro families in the Delta and Shortleaf Pine Area towns with housing values of $7.50 and under, and of $7.51 to $20.00. (By housing value is meant monthly rent or rental value of house or apartment unfurnished in which the family resides.)[2] Families with housing values of more than $40.00 were not included in this study, since there were too few of the 1,158 families to secure a large enough record sample.

Data were obtained in the summer of 1943 from records kept by homemakers and from schedules filled out by means of personal interviews with these women. White and Negro home economists supervised record keeping and secured other information by interviewing the homemaker.[3]

The homemakers were asked to keep a record of methods used in preparing 12 foods served in the home during one week. (See Appendix for record forms used.) The foods for which the records were kept were limited to: (1) cooked vegetables, (2) meat, fish, poultry, or eggs, (3) breads, and (4) vegetable salads. The homemaker was asked to limit records of any one food, such as cornbread, string beans, to 3, unless variety of foods served in this period was so limited that more than 3 records of a food must be kept to yield 12 preparation records. It was asked that records be kept of those foods ordinarily served when the food was in season and suggested that a good distribution would be six cooked vegetables, one vegetable salad (if served that often), and remaining five—breads, eggs, meat, fish, and poultry—as the homemaker preferred. It was requested that no changes in methods of preparation be made during the study. Measuring cups, spoons, and scales were furnished.

Other records kept by the homemaker during the week of the study were of her own activities during each day, of assistance in homemaking activities,[4] and of all foods served during this period. The supervisor obtained information from families in which records were kept concerning kind and condition of equipment for food preparation and concerning kitchen arrangement. She also secured information pertaining to family history of homemaker and male head that might throw some light on the food preparation pattern of the family. Data concerning family composition, schooling, food and nutrition education, and economic status were secured in the initial study from which these families were selected.

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[1] See "Changing Pattern of Food Preparation of Small Town Families in Mississippi," Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. 415, p. 3.

[2] Ibid., p. 8.

[3] Record keeping in 5 of the 80 white families was supervised by a home economics club leader.

How Representative Are the Families

In the larger study, one or two general questions concerning the usual methods of preparation and/or serving 12 common foods had been obtained from each of the families. When the information obtained from the larger group and from the record keeping group of the same race and housing value are compared, somewhat better practices concerning preparation and/or serving were found on the part of the record sample than of the entire group. This was much more true of Negro families than of white families. Keeping records, even when one has the help of a supervisor, is too difficult for women of little schooling and thus cooperation of the near-illiterate is definitely limited. Median school grade completed by Negro homemakers in the larger study was the sixth, by record keeping Negro homemakers in this study, the eighth. Median grade completed by white homemakers in both groups was the twelfth.

Also, it may be that there is more interest in keeping food preparation records on the part of those who have better practices. The fact that record keepers with the same schooling as non-record keepers reported, for example, somewhat greater use of milk and eggs in cooking, more enriched flour, less draining of canned beans, would indicate that record keeping may select those with somewhat better practices.

Records of Food Preparation

The 160 white and Negro homemakers in this study kept records of 1,857 of the dishes they served during the record week. The average number of preparation records kept of the different types of food per family (i.e., vegetables, meat and eggs, breads, vegetable salads) is given in table 1. As will be noted, white homemakers kept more records of vegetables and of vegetable salads; Negro homemakers more of meat and eggs and of breads. Vegetables and vegetable salads were more frequently served during the record week in homes of white families; breads in homes of Negro families (table a in Appendix). Greater frequency of preparation would, therefore. account for more records being kept. The reason that Negroes kept more records of meat and egg dishes, when fewer of these dishes were prepared than in case of whites (table a in Appendix), may be that they wanted to cooperate by furnishing 12 records, yet variety of foods prepared was limited. Therefore, they had to keep more meat and egg preparation records. They preferred doing this to turning in a number of records of cornbread and biscuit preparation, though they were free to do so.

Preparation records of sliced tomatoes served to the family during the record week are included under vegetable salads, since the number of vegetable salads prepared in these 160 families during the study week was small (table a in Appendix). Sliced tomatoes are not a vegetable salad, but since they were frequently used and since their preparation, it was thought, would be indicative of the way the family would prepare salad, it

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[4] For a complete report on time expenditures in homemaking activities of these families, see "Time Activities in Homemaking," Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. No. 424, Oct. 1945.

Table 1. Total number of food preparation records and average number of records per family kept by white and Negro homemakers classified by food type and housing value.

Food type	White families				Negro families			
	Housing value $20 and under		Housing value $20.01-$40.00		Housing value $7.50 and under		Housing value $7.51-$20.00	
	No. records	Av. per family	No. records	Av. per family	No. records	Av. per family	No. records	Av. per family
Vegetables	245	6.0	217	5.6	200	5.1	218	5.3
Meat and eggs	96	2.3	129	3.1	141	3.6	154	3.8
Breads	68	1.7	66	1.7	87	2.2	91	2.2
Vegetable salads*	48	1.2	42	1.2	22	.6	33	.8
Total	457	11.2	454	11.6	450	11.5	496	12.1
Number of families	41		39		39		41	

*Including sliced tomatoes. See table a in Appendix.

Table 2. Average number of poor preparation practices per type of food for which records were kept by race and housing value of family.

Food type	White families		Negro families	
	Housing value $20.00 and under	Housing value $20.01-$40.00	Housing value $7.50 and under	Housing value $7.51-$20.00
	No. poor practices per record	No. poor practices per record	No. poor practices per record	No. poor practices per record
Vegetables	2.4	1.9	2.6	2.4
Meat and eggs	.3	.2	.4	.3
Breads	.2	.3	.2	.3
Vegetable salads	.3	.3	.4	.5
Number of families	41	39	39	41

was decided to accept records for preparing sliced tomatoes.

Table b in the Appendix gives a complete list of foods for which preparation records were kept. Records of preparation of Irish potatoes, field peas (common name for cowpeas), butter beans (common name for small lima beans), string beans, corn, and okra were the vegetables records most often submitted. All these vegetables were in season at the time of the study. More families kept records of cornbread preparation than of biscuit preparation. More Negro women submitted records of pork dishes; more white women of egg dishes. A number of both groups kept records of preparation of chicken, usually fried chicken. Chicken of frying size was in season at the time of the study.

Poor Preparation Practices

Poor preparation practices are practices that are contrary to recommendations of food and nutrition specialists. Some homemakers in preparing a particular dish followed four or even more practices contrary to recommendations of specialists, while others observed in every detail recommendations of specialists. Table 2 gives the average number of poor preparation practices by food type for the four groups of families.

As will be noted, there were many more poor practices in connection with preparation of cooked vegetables than with the preparation of meat and eggs, with breads, and with vegetable salads. This was because vegetables contain vitamins very easily destroyed by poor methods of cooking and storage. There has been more research on losses in cooking vegetables than in the case of foods of other types and, therefore, more possibility for vegetable practices receiving a poor rating. Then, again, in vegetable cooking we

Table 3. Poor preparation practices used by white and Negro families in cooking vegetables.

Poor preparation practices	White families		Negro families	
	Housing value $20.00 and under	Housing value $20.01-$40.00	Housing value $7.50 and under	Housing value $7.51-$20.00
	Percent of vegetable records kept using practice			
Starting vegetables in cold water	63.7	52.5	50.5	55.1
Excessive cooking	43.3	36.9	62.0	47.7
Poor storage between cooking and serving	64.5	49.8	69.0	67.0
Poor storage between harvesting or purchasing and cooking	26.1	9.7	8.0	5.5
Poor storage between serving at first and second meal	30.0	21.2	18.0	22.9
Soaking in water after preparation for cooking	6.1	2.8	16.0	16.5
Parboiling	4.1	3.7	10.5	7.8
Soda to tender	*	*	7.5	6.9
Washing in soda water	0	0	11.0	5.1
All other poor practices	8.6	16.1	9.5	8.7
Number of vegetable preparation records	245	217	200	218

*Less than 0.5 percent.

have the problem of the cooking water which is sometimes drained off during cooking or after cooking is complete.

In table 3 are listed kinds of poor practices found in the 880 records kept of vegetables. Most frequent poor practices by white and Negro women were starting vegetables in cold water, excessive cooking, and poor storage between cooking and serving.

The frequency of starting vegetables in cold water was probably related in part to the kind of vegetables used. Records of preparation of butter beans, field peas, Irish potatoes, and corn constituted somewhat more than 50 percent of the vegetable records. In a previous study it was shown that some homemakers had been taught by their mothers or someone in the parental homes, preparation rules such as: "Put all vegetables except leafy vegetables on in cold water." "Starting beans and peas in cold water makes more tender."[5] Evidently, a number of homemakers were following preparation rules learned from mother. Nutritionists advise starting vegetables in boiling water to reduce cooking time and destroy oxidases quickly.

Since time of cooking varies with kind of vegetable, with maturity of vegetable, with quantity cooked, with size and kind of cooking utensil, it was often difficult to draw a dividing line between overcooked and properly cooked vegetables. Vegetables classified as "excessive cooking" are those which were without doubt cooked too much. In making this classification, the time table for boiling vegetables given in "Hows and Whys of Cooking," by Halliday and Noble, was consulted.[6]

The practice of allowing a sufficiently cooked vegetable to remain in the warmer, in the oven, or on the back of the stove until served was regarded as poor storage between cooking and serving. Vegetables were cooked oftentimes in the middle of the morning and kept warm after cooking until dinner time when they were served. This practice was classified as poor storage between cooking and serving. Keeping vegetables warm until served was not considered a poor practice when total time of cooking and of keeping warm did not exceed time regarded as excessive cooking.

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[5] Traditional Food Preparation Rules, Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. No. 418.

[6] Hows and Whys of Cooking, E. G. Halliday and I. T. Noble, Univ. of Chicago Press, p. 24, 1941.

The practice of cooking foods in the early morning to be served at noon is said to have come originally from desire to reduce to the minimum heat from cooking in the house. In farm homes in which most of these homemakers were reared, wood was used as fuel and continued heat in the kitchen is especially enervating in warm weather.

Fifty-one of the 80 white families and one of the 80 Negro families had gas, electric, or oil cookstoves. Seventy-one percent of the vegetable dishes in white families and 68 percent in Negro families with wood and/or coal cookstoves only, were poorly stored from time between cooking and serving. Forty-six percent of the vegetable dishes, in white families with gas, electric, or oil cookstoves, were poorly stored between cooking and serving. It would thus seem that the poor practice is not entirely due to absence of an electric, gas, or oil cookstove. It may be that practices have been held over from parental homes where wood cookstoves were used. Work schedules as well as methods of preparation may be handed down from mother to daughter.

Storage of vegetables indoors, usually in the kitchen (not refrigerated) overnight before using and/or preparing vegetables for cooking the afternoon or night before were classified as poor storage between harvesting and cooking. Twenty-six percent of the vegetable records kept by homemakers in white families of $20.00 and under housing value, used poor storage between harvesting or purchasing and cooking. About 8 percent of the vegetable records kept by homemakers in the other three groups had this poor practice. Homemakers in white families of $20.00 and under housing value were particularly prone to harvest vegetables the afternoon of the day before using and to prepare them then. Shelling butter beans and field peas ahead was fairly common. Research studies show that beans and peas stored in pods lose less vitamin C than if stored shelled.

An important factor no doubt responsible for homemakers in white families of $20.00 and under housing, shelling peas and beans ahead of time more frequently than homemakers in other groups was that they had more young children. Preparing vegetables ahead was perhaps one means of distributing their work load. They spent, during the record week, an average of 69 hours in homemaking activities. Total time spent by homemakers in the higher housing value white group averaged 63 hours, and by Negro homemakers in both housing value groups, 60 hours.[7] Homemakers need a list of food activities that can best be done in advance.

There were three general types of supper meals served by families of this study during the study period: (1) left-overs from dinner, (2) sandwiches, (3) a meal somewhat resembling breakfast. The first was the most common. It was more common among white families than among Negro families. It was more common in white families of low housing than of high housing value. Vegetables left from dinner were usually eaten without being reheated. Sometimes these vegetables were stored in safes (a movable stand with shelves, closed back and sides, and screened doors in front, used for keeping provisions from insects), in the oven, or in the warmer, in the interval between dinner and supper. No relation was found in ownership of a refrigerator, or in type of refrigerator, and storage of vegetables between meals. However, all white families, except one, owned either an ice or a mechanical refrigerator. Only 12 Negro families did not have a refrigerator of either kind. These 12 families kept few vegetables from one meal to the next. In fact, some of them served no supper meal at all.

The practice of storing left-over vegetables on stoves or in safes has no doubt been carried over from the time when there were no refrigerators. The factor responsible for continuation of this practice on the part of some is preference for vegetables such as those that remain at room temperature. The fat hardens on refrigerated vegetables and this is unpalatable. Then, too, space in refrigerators is often quite limited. Homemakers need instruction concerning foods that can best be left out of the refrigerator.

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[7] Time Activities in Homemaking, Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. No. 424, 1945.

As will be noted, the practice of using soda in preparation of vegetables was almost altogether limited to Negro families (table 3). Recent studies have shown that the use of soda is not destructive of vitamins when only a small amount is used and the vegetable cooked until tender and no longer, and served soon after. However, families in this study using soda cooked the vegetable excessively and/or allowed it to stand on a stove for some time before serving.

It is interesting here to note that even though a number of homemakers used poor practices in vegetable preparation, most vegetables were eaten and liked by family members. All family members were reported as having eaten 95 percent of the vegetable dishes for which records were kept. However, record keeping was limited to those vegetable dishes ordinarily served when the vegetable was in season.

Poor practices in meat and egg preparation were in most cases frying meat and eggs in smoking grease, or boiling rather than simmering eggs. Other poor practices included cooking chicken in water in which soda had been added in order to make tender, soaking young chicken in soda water, soaking liver in boiling water before cooking to draw out the blood.

Poor practices in bread preparation included, for the most part, using more soda than the recommended amount, one-half teaspoonful to a cup of sour milk. (This amount would vary with acidity of the milk and for this reason some of the bread records may have been incorrectly rated.) Several white homemakers prepared rolls with yeast, soda and baking powder. The use of such a recipe was regarded as a poor practice, since no sour milk was used to neutralize the soda, and since sufficient yeast had been added to make rolls light. Use of excess soda gives a yellow color and a disagreeable flavor. In addition, an alkaline reaction favors the destruction of thiamin by heat.

The most common poor practice in connection with preparation of sliced tomatoes was slicing sometime before the meal and placing on the dining table where they would be eaten later. Other poor preparation practices in salad preparation included grinding cabbage for slaw; peeling, cutting into small pieces, boiling, then draining potatoes for potato salad; cutting up fine all vegetables and allowing to stand in water before drained and made into salad.

Food Preparation Rated

Poor practices found in preparation records of each homemaker were checked, totaled, and divided by number of food preparation records kept. Families were then classified into three groups. (1) **Good preparation.** Less than 1 poor practice per dish; (2) **Fair preparation.** From 1 to 1.5 poor practices per dish; (3) **Poor preparation.** More than 1.5 poor practices per dish. This classification has two main weaknesses: (1) All poor practices are not equally poor; (2) Families in which more vegetable records were kept were more likely to have a lower preparation rating than other families. One might say in answer to these two criticisms that very poor practices and many poor practices seemed to be related and that most families kept about the same number of vegetable preparation records.

The method of classifying families according to number of poor practices per dish prepared for which a record was

Table 4. Food preparation ratings of families with pre-school and/or school children and with no pre-school and/or school children.

Food preparation rating	White families		Negro families	
	With children	With no children	With children	With no children
	Percent	Percent	Percent	Percent
Good	32	33	27	21
Fair	36	30	46	48
Poor	32	37	27	31
Total	100	100	100	100
Number of families	53	27	51	29

Table 5. Food preparation ratings of families and age of homemaker.

Food preparation rating	White families		Negro families	
	Homemaker under 45 years	Homemaker 45 to 60	Homemaker under 45 years	Homemaker 45 to 60
	Percent	Percent	Percent	Percent
Good	39	19	27	20
Fair	28	44	51	40
Poor	33	37	22	40
Total	100	100	100	100
Number of families*	57	16	63	15

*Seven white homemakers and two Negro homemakers were 60 years or over.

kept, will be used in this bulletin. No detailed information concerning methods of preparing particular dishes or foods will be given here. These data will be combined with preparation data obtained by the schedule method from several hundred other families and included in another report.

Twenty-nine percent of the 160 families were rated as having good preparation, 40 percent as fair preparation, and 31 percent as poor preparation when classified by the method described above.

Family Composition and Food Preparation Rating

As will be noted from table 4, there was a tendency for families with pre-school and school children to have somewhat better food preparation ratings. In this study, homemakers in families with children were younger than homemakers in families without children and since younger homemakers made higher food preparation ratings than older homemakers (table 5), families with children would be expected to have higher food preparation ratings. Younger homemakers without children were not, as a rule, interested in cooperating in this record study.

In a previous study of this series[8] a tendency on the part of older homemakers to try fewer new dishes within a stated period of time than of younger homemakers was found. Nutrition investigators are making available from day to day results of studies on conservation of food value in cooking, and hence the group who fails to change with new recommendations is the group using more poor practices.

Since smaller families of this study were more often families with older homemakers, there was a tendency, though not marked, for smaller families to have lower food preparation ratings than larger families. Thirty-six percent of the white families of two members and 39 percent of four or more members, had preparation ratings of good, while 22 percent of the Negro families of two members and 30 percent of four or more

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[8] Changing Pattern of Food Preparation of Small Town Families in Mississippi, Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. No. 415, 1945.

Table 6. Food preparation ratings of families and schooling of homemaker.

Food preparation ratings	White families			Negro families		
	Homemaker completed 10 grades or less*	Homemaker completed 11 or 12 grades	Homemaker had college training	Homemaker completed 6 grades or less	Homemaker completed 7 to 9 grades	Homemaker completed 10 grades or more
	Percent	Percent	Percent	Percent	Percent	Percent
Good	21	36	46	5	32	27
Fair	45	32	23	56	40	50
Poor	34	32	31	39	28	23
Total	100	100	100	100	100	100
Number of families	29	25	26	18	40	22

*One homemaker had completed only 6 grades; the remainder had had more schooling.

members had preparation ratings of good. White families of this study averaged 3.5 members, Negro families 3.6 members. Median size of family (the size halfway between the largest and smallest) for both whites and Negroes was three members.

The fact that younger homemakers, especially younger Negro homemakers, had more schooling than older homemakers may account, at least in part, for differences in food preparation ratings of older and younger women. More schooling makes for more understanding of the printed word, in which form findings of research in food preparation are available. Most of the white homemakers with college training, and most of the Negro homemakers with 10 grades or more schooling, were under 45 years of age. Figure 1 shows preparation rating of white and Negro homemakers with varying amounts of schooling.

In table 6 is given food preparation ratings of families with homemakers of varying amounts of schooling. As will

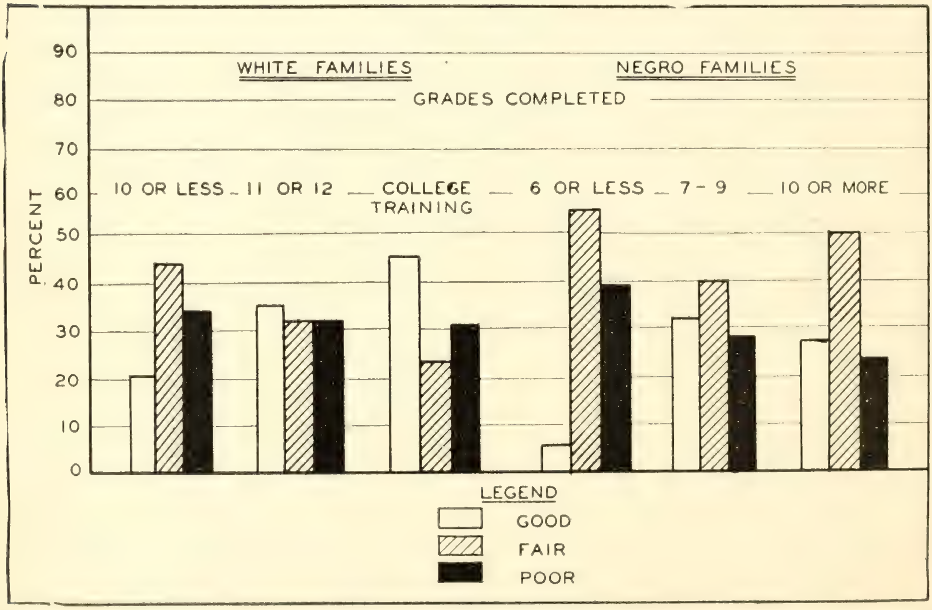

Figure 1. Food preparation ratings of white and Negro families and schooling of homemaker.

be noted, there were twice as many white families and five times as many Negro families with preparation ratings of good in families classified in category of most schooling for homemaker as classified in category of least schooling for homemaker. The fact that there were 19 women with less than seven grades schooling willing to cooperate in this study, was because other members of their families with more schooling were willing to keep the records for them and, also, because they had a supervisor to assist them.

Foods courses, such as are taught in departments of home economics of junior high schools, senior high schools, colleges, and by agricultural extension clubs, give up-to-date information on food preparation. Unfortunately, classroom and club teaching is not always carried back into the home. Then, too, this subject matter is continually changing. Methods of preparation recommended in 1923 or 1933 cannot be used today. However, if food teachers do a good job, their students will be well aware of the changing nature of this science of food preparation and be ever on the alert for the latest developments.

Families in which there were one or more members who had had training in home economics were more likely to own books, bulletins, pamphlets, and to subscribe to magazines dealing with food in its various aspects.

In table 7 and figure 2, food preparation ratings of families with one or more members having studied home economics in school, college, or club are compared with families with no member having had such training. About three-fourths of the white families and four-tenths of the Negro families had one or more members with some training in home economics—a much higher proportion than was the case with families of the larger study from which these families were drawn. More home economics training in families of this record sample may have been one factor in their better rec-

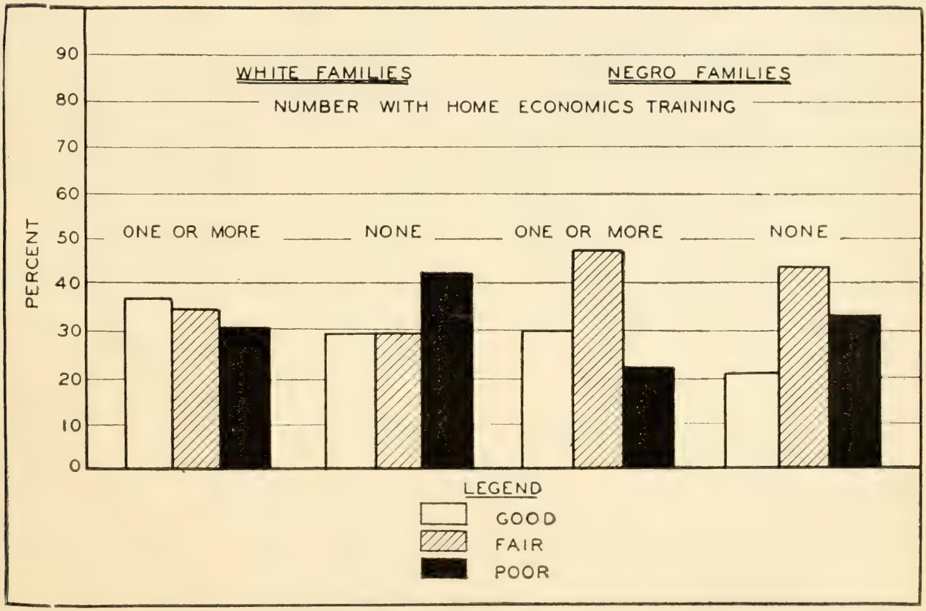

Figure 2. Food preparation ratings of white and Negro families with one or more members having had home economics training and with no member having had home economics training.

Table 7. Food preparation ratings of families in which one or more members had had training in home economics in school, college and/or agricultural extension clubs and in which no member had had training in home economics, college, and/or agricultural extension clubs.

Food preparation ratings	White families		Negro families	
	One or more members with training in home economics	No member with training in home economics	One or more members with training in home economics	No member with training in home economics
	Percent	Percent	Percent	Percent
Good	36	29	30	21
Fair	34	29	48	45
Poor	30	42	22	34
Total	100	100	100	100
Number of families	59	21	33	47

Table 8. Food preparation ratings of families classified by housing value.

Food preparation ratings	White families		Negro families	
	Housing value $20 and under	Housing value $20.01-$40.00	Housing value $7.50 and under	Housing value $7.51-$20.00
	Percent	Percent	Percent	Percent
Good	25	44	23	27
Fair	29	38	44	49
Poor	46	18	33	24
Total	100	100	100	100
Number of families	41	39	39	41

ord of use and preparation of 12 foods than that of the larger group from which they were drawn.

Economic Status of Family and Food Preparation Rating

Housing value (monthly rent or rental value, unfurnished, of house or apartment in which the family resided) was used in this study as a basis for classifying families into economic groups. As will be noted from table 8 and figure 3, forty-six percent of the white families with housing values of $20.00 and under, and 18 percent with housing values of $20.01 to $40.00, had preparation ratings of poor. Thirty-three percent of the Negroes with housing values of $7.50 and under, and 24 percent with housing values of $7.51 to $20.00, had preparation ratings of poor. Members of families residing in houses of less value had completed fewer grades in school. The women and girls in these families had less often studied home economics. These families had less reading material to assist them in better food preparation. Facilities for food preparation were not as good as for the group with higher housing value. The low socioeconomic status family is, therefore, doubly disadvantaged as far as food consumed by the family is concerned. The food supply it consumes is less adequate in amounts of the various nutrients. The methods of preparation and/or serving they use are less likely to be methods that conserve the nutrients.

Family Background of Homemaker and Male Head and Food Preparation Rating

Husbands and wives in families of this study were rather homogeneous as far as family background was concerned. On the family history schedule, the following question was asked: "Any other factors that might account for methods of food preparation used: nationality of homemaker and male head, religion, experience of parents or grandparents?" Practically all homemakers and male heads in the 160 families included were Protestant, native white or Negro, reared on a Mississippi

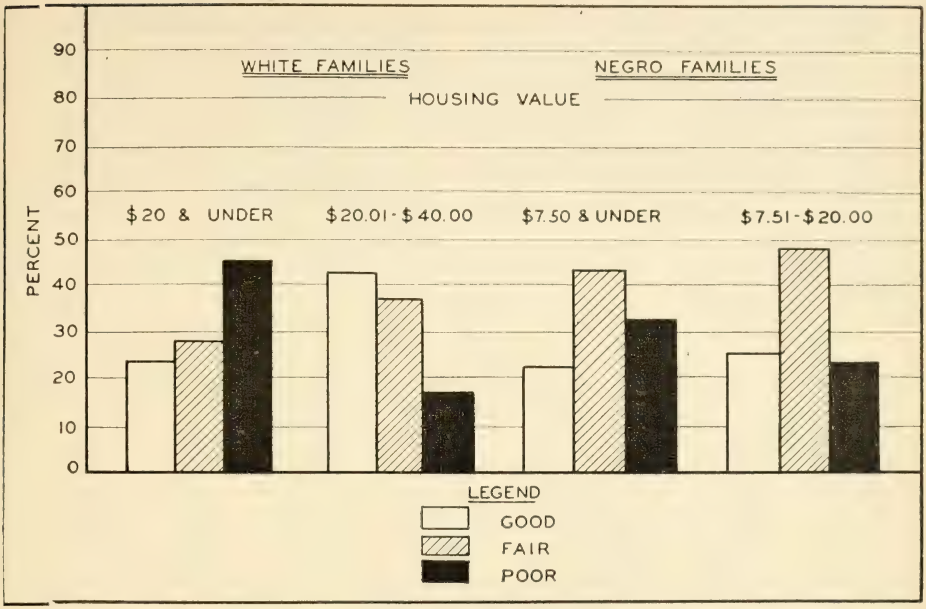

Figure 3. Food preparation ratings of white and Negro families classified by housing value.

farm. In only 13 families, 10 white and 3 Negro, had both male head and homemaker been reared in town. In only three families had both been reared outside the State, and in two of these families they had been reared in another Southern state.

In nearly 60 percent of the Negro families, either the homemaker, male head, or their parents had been house servants in the home of a white family, during which period they had eaten in the home of this family. Homemakers in 30 of the 80 Negro families had, themselves, worked and eaten regularly in homes of white families.

As will be noted from table 9, Negro homemakers who had eaten regularly in homes of white families, less often had food preparation records scoring poor than did those who had not had this experience. However, there were slightly more Negro homemakers scoring good in food preparation in the group who had never eaten regularly in the home of a white family. Included in this group were Negro women who were especially advantaged as far as schooling and economic status were concerned.

All except 12 white and 14 Negro

Table 9. Food preparation ratings of Negro families in which the homemaker had and had not at one time eaten regularly in the home of a white family.

Food preparation ratings	Homemaker had eaten regularly in home of white family	Homemaker had not eaten regularly in home of white family
	Percent	Percent
Good	23.3	26.0
Fair	53.4	42.0
Poor	23.3	32.0
Total	100.0	100.0
Number of families	30	50

homemakers of this study had assisted with preparation of food in parental homes. Assistance ranged from watching the bread or turnip greens to doing all the cooking for the parental family. The principal reasons given for no preparation experience in parental home was a sister helping with the cooking, and the homemaker being responsible for other household or farm tasks, and not being permitted by the cook to come into the kitchen. There was a rather marked tendency for families in which the homemaker had not had experience in food preparation in her parental home to make higher preparation ratings. It may be that women without previous experience in preparation are less tradition bound. However, the number of cases of those without preparation experience in parental home was small. Methods used in the preparation of vegetables and breads were often reported by homemakers as those taught them in their parental homes. The source of the methods of preparation for meats and for vegetable salads was less often that of the parental home.

Male heads in 25 of the white families and in 18 of the Negro families had assisted parental families with food preparation. One homemaker stated that her husband had taught her to cook.

Time Expenditures in Food Preparation and Scheduling of Homemaker

Most of the dishes for which records were kept were prepared by the homemaker. Ninety-four percent of the breads, 91 percent of the vegetable dishes, 90 percent of the meat dishes, and 80 percent of the salads were thus prepared.

White families in which the minimum time was spent in food preparation more often made preparation ratings of good than did white families in which the maximum time was spent in food preparation (table 10). In the Negro families, however, there were slightly more ratings of good in the group spending the maximum time, but more ratings also of poor in this group. Homemakers, both white and Negro, in families with poor preparation ratings spent on the average a little more time in food preparation than did those in families with good ratings.

There was, however, a closer relationship in the time in which the homemaker scheduled food preparation activities and

Table 10. Food preparation ratings of white and Negro families and total time spent in food preparation per family per week.

Group	Total time spent in food preparation by all persons during record week		
	Less than 15 hours	15 to 18 hours	More than 18 hours
	Percent	Percent	Percent
White families			
Preparation ratings:			
Good	45.0	39.1	24.3
Fair	15.0	26.1	46.0
Poor	40.0	34.8	39.7
Total	100.0	100.0	100.0
Number of families	20	23	37
Negro families			
Preparation ratings:			
Good	18.5	36.0	21.4
Fair	51.8	44.0	42.9
Poor	29.7	20.0	35.7
Total	100.0	100.0	100.0
Number of families	27	25	28

food preparation ratings than in the total time she spent in such activities and food preparation ratings. As will be noted from table 11 and figure 4, when the interval between beginning preparation and serving dinner was 1½ hours or less, 55

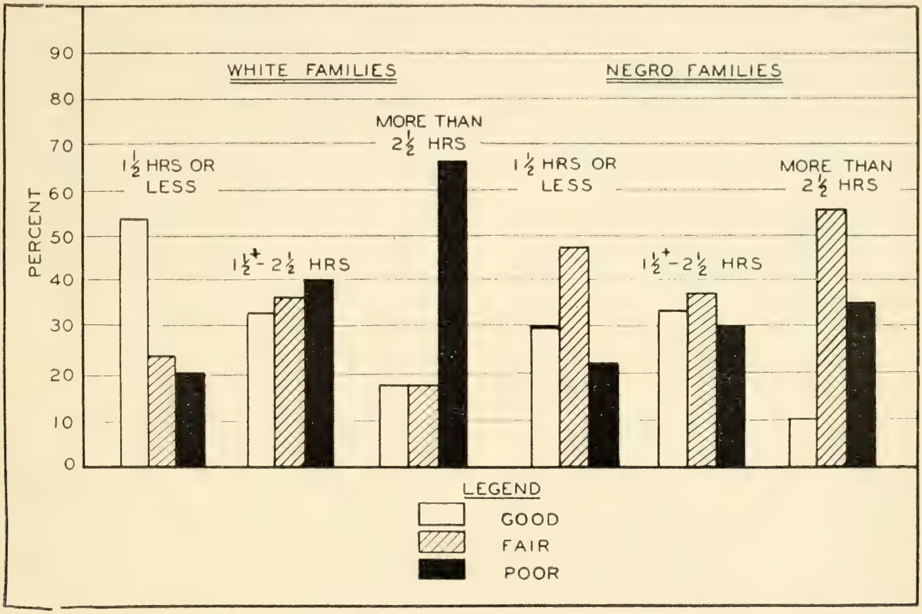

Figure 4. Food preparation ratings of white and Negro families and interval between beginning preparation and serving dinner.

Table 11. Food preparation ratings of white and Negro families and interval between beginning preparation and serving dinner (Monday through Friday).

Group	Time (median) between beginning preparation and serving dinner		
	1½ hours or less	More than 1½-2½ hrs.	More than 2½ hours
White families	Percent	Percent	Percent
Preparation ratings:			
Good	55.2	23.3	16.7
Fair	24.1	36.7	16.7
Poor	20.7	40.0	66.6
Total	100.0	100.0	100.0
Number of families*	29	30	12
Negro families			
Preparation ratings:			
Good	29.6	33.3	10.0
Fair	48.2	37.1	55.0
Poor	22.2	29.6	35.0
Total	100.0	100.0	100.0
Number of families	27	27	20

*In 9 white families and 6 Negro families, homemakers did not, themselves, prepare dinner as many as 4 days out of the Monday-Friday period. These 15 families are not included in the tabulation. This tabulation is limited to the Monday-Friday period, since time expenditures of homemakers on Saturday and Sunday differed greatly from expenditures during the remainder of the week.

percent of the white families and 30 percent of the Negro families rated good, 21 percent of the white families and 22 percent of the Negro families rated poor. When the interval between beginning preparation and serving was more than 2½ hours, 17 percent of the white families and 10 percent of the Negro families rated good, 67 percent of the white families and 35 percent of the Negro families rated poor. A homemaker may put her greens on at 9:00 a. m. and leave them cooking while she cleans house and does the laundry, or she may clean the house and start the laundry before putting on the greens. In either case, her time expenditures in preparation of the greens would be the same. The product, however, would differ.

Time scheduling is important in food preparation. That there was such a close relation in time of starting dinner and rating in food preparation was because starting dinner early usually meant starting vegetables early and this meant overcooking or having to keep them warm until serving time, or both. Of those white families in which all vegetables, for which records were kept, were excessively cooked and/or stored warm until served, the interval between beginning dinner preparation and serving dinner of 14 percent was 1½ hours, and of 50 percent, more than 2½ hours (table 12). Percentages for corresponding groups in which 50 percent or fewer vegetables, for which records were kept, were excessively cooked and/or stored warm until served were 50 and 17, respectively.

Poor cooking practices are no doubt tied up in part with time patterns inherited by homemakers from the past. There is need for continual study of best time for doing various preparation tasks. Which foods can be prepared first and which reserved for last minute preparation? The answer to these questions changes with the developments of research, new products, and equipment. Then, too, other tasks of the homemaker must be considered, for food preparation is only one of a number.

Type of Menu Served and Preparation Rating

From table 13, it would seem that families serving the least and the most dishes during the study week were more likely to have poorer methods of preparation than those serving a moderate number. The group serving 75 or fewer dishes during the study week were Negro families of low economic status. They had had little schooling and had been less often exposed to modern food preparation instruction. Facilities for preparing and for serving were limited.

Dishes served were of three types: (1) prepared dishes, (2) left-overs, and (3) ready prepared dishes. For example, fried steak, scalloped potatoes, biscuit, if

Table 12. Interval between beginning dinner preparation and serving dinner, and proportion of vegetables served cooked too long and/or stored hot too long before serving.

Proportion of vegetables served which were cooked too long and/or stored hot too long before serving	White families			Negro families		
	Interval between beginning dinner preparation and serving dinner*			Interval between beginning dinner preparation and serving dinner*		
	1½ hours or less	More than 1½-2½ hrs.	More than 2½ hours	1½ hours or less	More than 1½-2½ hrs.	More than 2½ hours
	Percent	Percent	Percent	Percent	Percent	Percent
100 percent	14.3	38.7	50.0	44.5	55.6	70.0
Fewer than 100 percent, more than 50 percent	35.7	38.7	33.3	40.7	40.7	30.0
50 percent or fewer	50.0	22.6	16.7	14.8	3.7	0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of families	28	31	12	27	27	20

*Limited to the Monday-Friday period for reasons previously stated.

Table 13. Food preparation ratings of white and Negro families and total number of dishes served at meals during the record week.

Group	Number dishes served at meals per family per week		
	75 and under	76 to 110	111 and over
	Percent	Percent	Percent
White families			
Preparation ratings:			
Good	—	39.3	30.8
Fair	—	35.7	30.8
Poor	—	25.0	38.4
Total	—	100.0	100.0
Number of families	—	28	52
Negro families			
Preparation ratings:			
Good	17.9	32.5	—
Fair	51.3	40.0	—
Poor	30.8	27.5	—
Total	100.0	100.0	—
Number of families	39	40	1

prepared for the meal in which served, were considered as prepared dishes. Prepared dishes left from a previous meal were classified as left-overs. Milk, butter, crackers, bakery rolls, jelly (either homemake or purchased) are examples of ready-prepared dishes. These dishes are in a form ready for eating with little or no expenditure of time in preparation.

About 11 percent of the dishes served by white families serving from 76 to 110 dishes during the study week were left-overs. About the same percentage served by Negro families serving fewer than 76 dishes and serving from 76 to 110 dishes during this period were left-overs. However, 20 percent of the dishes served by white families serving more than 110 dishes were left-overs. Many families in the white group serving so many dishes were following the traditional menu pattern for supper—left-overs from dinner for supper. This meant for supper a repetition of dinner rather than a simpler meal. Homemakers who follow traditional menu patterns may also follow traditional methods of preparation. This would account for lower preparation ratings with the greater use of left-overs.

In table 14, white and Negro families in the three preparation rating groups are classified according to number of left-overs served during the record week. As will be noted, families serving the greatest number of left-overs more often had preparation ratings of poor, while those serving the fewest number more often had preparation ratings of good or fair. Cooked vegetables even when stored covered in the refrigerator lose some nutritive value. Therefore, the practice of serving for supper left-over vegetables from dinner is not desirable. From a nutritional standpoint, a supper with a hot dish and fresh salad or fruit, or of sandwiches, salad, and fruit, is more desirable.

Families serving more prepared and ready-prepared dishes, more often had food preparation scores of good than those serving fewer of these dishes. Those serving fewer prepared and ready-prepared dishes more often had food preparation ratings of poor (table 15). The fact that families of higher economic status served more prepared and ready-prepared dishes would account in part for their better preparation ratings (table 8).

Equipment and Utensils for Food Preparation and Preparation Rating

Kitchen equipment such as a sink with drain boards, an electric, gas or oil cookstove, a mechanical refrigerator, were not

Table 14. Food preparation ratings of white and Negro families and number of left-over dishes served during study week.

Group	Number of left-over dishes served at meals per family per week		
	7 and under	8-18	19 and over
	Percent	Percent	Percent
White families			
Preparation ratings:			
Good	61.5	48.0	16.7
Fair	30.8	28.0	35.7
Poor	7.7	24.0	47.6
Total	100.0	100.0	100.0
Number of families	13	25	42
Negro families			
Preparation ratings:			
Good	31.6	16.7	25.0
Fair	44.7	53.3	33.3
Poor	23.7	30.0	41.7
Total	100.0	100.0	100.0
Number of families	38	30	12

Table 15. Food preparation ratings of white and Negro families and number of prepared dishes and of ready-prepared dishes served at meals during study week.

Group	Number prepared dishes			Number ready-prepared dishes		
	45 & under	46 - 60	61 & over	Under 20	20 - 35	36 & over
	Percent	Percent	Percent	Percent	Percent	Percent
White families						
Preparation ratings:						
Good	—	27.5	38.5	—	24.1	40.1
Fair	—	25.0	41.0	—	34.5	25.0
Poor	—	47.5	20.5	—	41.4	34.9
Total	—	100.0	100.0	—	100.0	100.0
Number of families	1	40	39	7	29	44
Negro families						
Preparation ratings:						
Good	19.5	37.1	—	19.6	36.7	—
Fair	47.2	37.1	—	45.7	43.3	—
Poor	33.3	25.8	—	34.7	20.0	—
Total	100.0	100.0	—	100.0	100.0	—
Number of families	36	35	9	46	30	4

owned by Negroes to any extent and, therefore, it is not possible to compare preparation ratings of groups with and without such equipment. Only two of the 80 Negro families had kitchen sinks with one or more drain boards; only one an electric, gas or oil cookstove; only 8 mechanical refrigerators.

In table 16, the relation of ownership of these three types of equipment by white families and their food preparation ratings are shown. Families who did not own this equipment made more frequently low food preparation ratings. Difference in economic status of the groups owning and not owning the equipment may account for much of the difference in preparation ratings.

That ownership of an electric, gas, or oil cookstove seemed more favorable than did ownership of a sink with drains or a mechanical refrigerator was, as has been previously suggested, because homemakers with wood and/or coal ranges only, often cook dinner in the cool of the morning to avoid having continued heat in

Table 16. Relation of ownership of sink with one or more drains, an electric, gas or oil stove, and mechanical refrigerator to food preparation rating of 80 small town white families of Mississippi.

Group	Equipment owned					
	Sink 1 or 2 drains		Electric, gas or oil stove		Mechanical refrigerator	
	Yes	No	Yes	No	Yes	No
	Percent	Percent	Percent	Percent	Percent	Percent
White families						
Preparation ratings:						
Good	36.7	32.0	39.2	24.1	32.7	35.7
Fair	43.3	26.0	35.3	27.6	36.5	25.0
Poor	20.0	42.0	25.5	48.3	30.8	49.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of families	30	50	51	29	52	28

the kitchen. (All white families except one not having a mechanical refrigerator, had an ice refrigerator; only 14 of the 50 families not having a sink with drains had no sink; and the remaining 36 had a sink with no drain boards.) They keep the dinner warm until noon when it is served. This practice is destructive of vitamins. Figure 5 shows the preparation ratings of white families with and without electric, gas or oil cookstoves.

There seemed to be little relation in ownership of common cooking utensils and preparation rating (table c in Appendix). In other words, families owning double boilers or equivalent made about as good preparation ratings as those not owning them. Families owning roasting pans made about as good ratings as those who did not. However, families with measuring cups and spoons and with paring knives, more frequently had good ratings, less, poor ratings.

Size of Kitchen and Preparation Rating

It was thought that size of kitchen

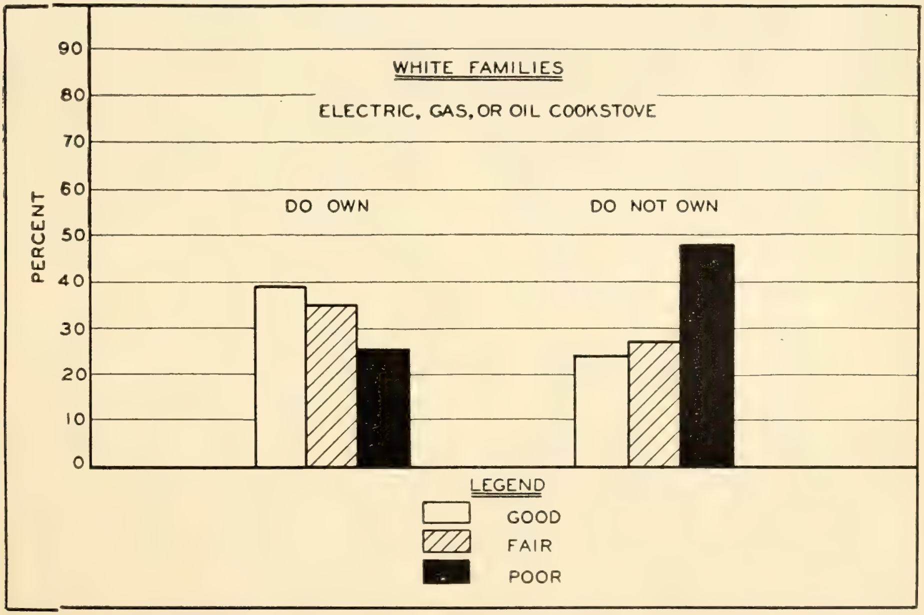

Figure 5. Food preparation ratings of white families and ownership of electric, gas or oil cookstove.

Table 17. Food preparation ratings of white and Negro families and size of kitchen.

Group	Size of kitchen: 100 sq. ft. and less	Size of kitchen: 101-160 sq. ft.	Size of kitchen: Over 160 sq. ft.
	Percent	Percent	Percent
White families			
Preparation ratings:			
Good	28.6	31.4	41.6
Fair	19.0	42.9	29.2
Poor	52.4	25.7	29.2
Total	100.0	100.0	100.0
Number of families	21	35	24
Negro families			
Preparation ratings:			
Good	17.9	25.7	35.3
Fair	50.0	51.4	29.4
Poor	32.1	22.9	35.3
Total	100.0	100.0	100.0
Number of families	28	35	17

might affect food preparation, a very large kitchen causing extra steps and time, a very small kitchen causing crowded work facilities, resulting also in loss of time. Such situations might encourage homemakers to start meal preparation sooner than would be the case with a kitchen of moderate size.

As will be noted from table 17, families, both white and Negro, with kitchens of 100 square feet and less, made lower ratings than did those with larger kitchens. Families with moderate sized kitchens more often rated fair and less often poor than did families with large or small kitchens. However, white and Negro families of this study with large kitchens were more likely to have food preparation ratings of good.

Storage Facilities and Preparation Rating

In table d in the Appendix, white and Negro families in the three food preparation rating groups are classified by kitchen storage facilities which they have. Families with kitchen closets or pantries, with built-in kitchen cabinets, with other kitchen cabinets such as cabinets with compartments for flour, sugar, a rolling board, and with cellars or outhouses, had better preparation ratings than did those without such facilities. This was, at least in part, because families with better storage facilities were also families of better economic status and education.

One interesting exception to the rule "ownership of storage facilities — better food preparation" was ownership of a kitchen safe, an outmoded piece of kitchen equipment, formerly quite popular for storage of cooked foods. Fifty-three percent of the white families and 38 percent of the Negro families with a kitchen safe had poor preparation ratings, while 28 percent of the white families and 25 percent of the Negro families having no kitchen safe had poor preparation ratings. Those with safes rated low because they used poor storage. Evidently those using better methods of storage had disposed of their safes.[9]

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[9] Distance from the kitchen to the garden was also another factor considered as affecting food preparation. If, for instance, the garden was far from the kitchen, the homemaker might gather or have gathered the vegetables ahead of time, storing them inadequately until preparation time, whereas, if the garden was near the kitchen, she might go out when she was ready to prepare the meal, gather the vegetables, bring them in, and cook them immediately. This may be true of farm families whose gardens are often far from the house. In these town families, distance of the garden did not seem important. However, the majority of gardens were less than 36 feet from the kitchen.

Table 18. Food preparation ratings of white and Negro families and convenience of dishwashing unit and storage place for dishes.

Food preparation ratings	White families		Negro families*	
	Storage place for dishes near dishwashing unit	Storage place for dishes not near dishwashing unit	Storage place for dishes near dishwashing unit	Storage place for dishes not near dishwashing unit
	Percent	Percent	Percent	Percent
Good	36.4	28.0	22.6	25.6
Fair	32.7	32.0	51.6	38.4
Poor	30.9	40.0	25.8	36.0
Total	100.0	100.0	100.0	100.0
Number of families	55	25	31	39

*In 10 Negro families dishes were stored on the table on which they were washed.

Table 19. Food preparation ratings of white and Negro families and convenience of stove to dining table.

Food preparation ratings	White families		Negro families	
	Stove near to dining table	Stove not near to dining table	Stove near to dining table	Stove not near to dining table
	Percent	Percent	Percent	Percent
Good	50.0	26.8	37.5	19.6
Fair	16.7	39.3	45.8	44.6
Poor	33.3	33.9	16.7	35.8
Total	100.0	100.0	100.0	100.0
Number of families	24	56	24	56

Convenience as well as possession of storage facilities and food preparation rating are related (table 18). Here, too, economic situation is one factor, families with dish cabinets near sinks more often being families of higher economic status.

Location of Dining Table With Respect to Stove and Serving Unit and Food Preparation Rating

According to Miss Maud Wilson, two important connections between working surfaces and areas concerned with preparation and consumption of food are: (1) stove near to dining table; (2) serving unit near to dining table.[10] These connections were investigated in this study as it was thought that convenience of stove to dining table, and of serving unit to dining table, might mean less standing around of food, and hence, better prepared food. "Near to" was defined as connecting or only two or three steps between, with no other equipment to be walked around.

Another connection mentioned as important by Miss Wilson was nearness of refrigerator to serving unit. However, in this study there were only 24 families (19 white and 5 Negro) with the refrigerator near the serving unit. Most of these 24 families were owners of mechanical refrigerators. Ice refrigerators are often kept outside the kitchen.[11]

When the stove and dining table were near, when the serving unit and dining table were near, there were more ratings of good food preparation, fewer of poor food preparation (tables 19 and 20). As will be noted, 50 percent of the white

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[10] The Williamette Valley Farm Kitchen, Maud Wilson, Oregon. Agri. Exp. Sta. Bull .No. 356, Aug. 1938, p. 17.

[11] Other connections studied were location of stove with respect to dishwashing unit; location of mixing unit with respect to dishwashing unit; location of dining table with respect to dishwashing unit. Families with these areas connecting or only two or three steps between with no other equipment to be walked around had no better, and in many cases not as good, preparation ratings than did those with areas not near.

Table 20. Food preparation ratings of white and Negro families and convenience of serving unit to dining table.

Food preparation ratings	White families*		Negro families*	
	Serving unit near to dining table	Serving unit not near to dining table	Serving unit near to dining table	Serving unit not near to dining table
	Percent	Percent	Percent	Percent
Good	45.8	20.8	30.8	18.4
Fair	20.8	39.6	38.4	50.0
Poor	33.4	39.6	30.8	31.6
Total	100.0	100.0	100.0	100.0
Number of families	24	48	13	38

*In 8 white families and 29 Negro families, the serving unit and the dining table were the same.

families and 38 percent of the Negro families with stove and dining table near made preparation ratings of good, while 27 percent of the white families and 20 percent of the Negro families in which this equipment was not near made preparation ratings of good (table 19). Forty-six percent of the white families and 31 percent of the Negro families with serving unit and dining table near, and 21 precent of the white families and 18 percent of the Negro families with this equipment not near made preparation ratings of good. This suggests that convenience of stove to dining table, of serving unit to dining table, may mean better prepared food. Further investigation is needed here.

Nearly 60 percent of the white families and about 75 percent of the Negro families ate entirely or most of the time in their kitchens. However, about 70 percent of the white families had a dining room or both dining room and breakfast room. Forty percent of the Negro families had a dining room. Families in this study who ate in the kitchen all or part of the time made on the whole somewhat better preparation ratings than families eating in another room.

Summary and Conclusions

The purpose of this investigation was to study some of the factors probably related to food preparation. The factors examined were family composition, schooling, and food and nutrition information of homemaker, economic status of family, family background of homemaker and male head, time expenditures in food preparation, scheduling of homemaker, type of menus served, equipment for food preparation, and arrangement of this equipment.

One hundred and sixty families were included—80 white families with housing value of $20.00 and under and of $20.01 to $40.00, and 80 Negro families with housing value of $7.50 and under and of $7.51 to $20.00. (Housing value is defined as monthly rent or rental value, unfurnished, of house or rooms in which the family resided.)

Data were obtained in the summer of 1943 from records kept by homemakers and from schedules filled out by means of personal interviews with these women. White and Negro home economists supervised record keeping and secured other information by interviewing the homemaker.

The 160 white and Negro homemakers kept records of 1,857 of the dishes they prepared during the record week. The dishes for which records were kept were limited to vegetables, meat and eggs, breads and vegetable salads. Most of the dishes for which records were kept were prepared by the homemaker—94 percent of the breads, 91 percent of the vegetable dishes, 90 percent of the meat dishes, and 80 percent of the salads. Food preparation of each family was rated according to average number of poor practices (or practices contrary to recommendations of food and/or nutrition specialists) per dish per preparation record kept. Families were classified into three groups: (1) **good preparation,** including those with less than one poor practice per dish; (2) **fair preparation,** those with from 1 to 1.5 poor practices per dish; (3) **poor preparation,** those with more than 1.5 poor practices per dish. Twenty-nine percent of the 160 families rated thus had good preparation, 40 percent fair preparation, and 31 percent poor preparation.

Families with younger homemakers made better preparation ratings. The fact that younger homemakers had more schooling than older homemakers was in part responsible. Schooling of homemaker and preparation rating seemed to be related.

Families in which one or more members had studied home economics in school, college, or club had somewhat better preparation ratings than those in which no member had had this training.

Families residing in houses of lower rent or rental value more frequently made preparation ratings of poor than did those residing in houses of higher rent or rental value. Homemakers in the lower housing value groups had less schooling. The lower housing value families less often had members who had studied home economics, less often had reading material to assist them in better food preparation, had poorer facilities for food preparation.

Negro homemakers who had eaten regularly in homes of white families less frequently had food preparation records scoring poor than did those who had not had a similar experience. However, there were slightly more Negro homemakers scoring good in food preparation in the group who had never eaten regularly in the home of a white family.

Methods used in the preparation of vegetables and of breads were often reported by homemakers as those taught them in their parental homes. The source of the method of preparation for meats and for vegetable salads was less often reported by homemakers as that taught them in parental home.

There was a tendency for those families in which the maximum time was spent in food preparation to have more often ratings of poor. There was likewise a tendency for families with homemakers spending more time in food preparation to have lower preparation ratings.

There was, however, a closer relationship in the time in which the homemaker scheduled food preparation activities and food preparation rating than in total time she spent in such activities and food preparation ratings. When the interval between beginning preparation and serving dinner was 1½ hours or less, 55 percent of the white families and 30 percent of the Negro families rated good, 21 percent of the white families and 22 percent of the Negro families rated poor. When the interval between beginning preparation and serving dinner was more than 2½ hours, 17 percent of the white families and 10 percent of the Negro families rated good, 67 percent of the white families and 35 percent of the Negro families rated poor. Starting dinner early often meant starting vegetables early and this meant overcooking or having to keep them warm until meal time.

Families serving the greatest number of left-overs at meals during the study week more often had preparation ratings of poor. The traditional supper meal is left-overs from dinner. Homemakers who follow traditional menu patterns may also follow traditional methods of preparation.

Families serving more prepared and ready-prepared dishes at meals during the study week more often had preparation ratings of good; those serving fewer of these dishes less often had ratings of good. The number of these two types of dishes served seems to be related to economic status of the family.

Families owning food preparation equipment such as a sink with one or two drains, an electric, gas or oil cookstove, a mechanical refrigerator, had better preparation ratings than those not owning such equipment. Ownership of an electric, gas or oil cookstove seemed favorable for good preparation. This was not only because families of higher economic status more often had such equipment, but because wood and/or coal ranges used in lieu of the others cause continued heat in the kitchen. To avoid this, many homemakers cook dinner in early morning, allowing it to remain on the stove until served. This practice is destructive of vitamins.

Families with kitchens of 100 square feet or less made lower preparation ratings than did those with larger kitchens. Small kitchens cause crowded work facilities and inadequate storage. Families with good storage facilities such as kitchen pantries, built-in cabinets, kitchen cabinets, had better preparation ratings than did those without such facilities. Convenience as well as possession of storage facilities seemed important in food preparation.

When the stove and dining table were near, and when the serving unit and dining table were near, there were more ratings of good preparation, fewer of poor food preparation. Convenience of this equipment may mean less standing around of food, and hence, better prepared food

Preparation ratings are the sum total of many factors. No single one can account for ratings of "good." In this particular investigation there were too few families to study the interrelationships of all the factors.

White families seemed a more homogeneous group on the basis of food preparation rating and education when analyzed statistically. There is need for further study of this problem, fór it is on the basis of such study that effective programs to improve practices can be developed.

From this study it would seem that better preparation would result (1) with more schooling, especially for homemakers in low socioeconomic families, since better preparation is dependent in part on better understanding of the spoken and printed word; (2) with home economics training for all homemakers; (3) with higher incomes for low socioeconomic status groups in order that they may obtain more of the material, and cultural equipment that makes better preparation more easily obtainable; (4) with clearer understanding on the part of home economics educators of the role of tradition in food preparation, in menu patterns, in time expenditure patterns and the source of such traditions; (5) with clearer understanding on the part of home economists of activities that go on in homes in order that better assistance can be given in time scheduling and in the choice, use, and arrangement of equipmnet that facilitates good preparation. Close coordination between management and food and nutrition is very much needed.

APPENDIX

Food Preparation

Schedule (a) Family No.________

I. HOUSEWIFE FILLS OUT

BREADS

DATE SERVED				
NAME OF BREAD				
If **meal,** whether bolted or unbolted. If **flour,** whether plain or self-rising; whether white not enriched, white enriched, or whole-wheat				
Recipe (measure and weights)				
Cooked in hot or moderate oven?				
Thickness when done (inches)?				
How long baked?				
Served at next meal? How?				

II. SUPERVISOR FILLS OUT

Source flour or meal				
Describe method of mixing				
Who prepared?				
From whom was method learned?				
Members of family not eating bread				

Food Preparation

Schedule (b) Family No. ____

I. HOUSEWIFE FILLS OUT

EGGS

DATE SERVED				
NAME OF DISH				
Recipe				
When put on to cook?				
When finish cooking?				
When served?				
If scrambled, or fried, grease smoking, not smoking? If boiled, in boiling water or water below boiling? If baked, in hot or moderate oven?				
Was white tender or hard?				

II. SUPERVISOR FILLS OUT

Source				
Who prepared food?				
From whom was method learned?				
Members of family not eating food				

Food Preparation

Schedule (c) Family No. ________

I. HOUSEWIFE FILLS OUT

LEAN MEAT, FISH, POULTRY

DATE SERVED				
NAME OF DISH				
Recipe (measures or weights) (Include anything added to tender)				
When put on to cook?				
When finished cooking?				
When served?				
If fried, grease smoking? Not smoking? If baked, oven hot, moderate, cool? If boiled in water, simmering or boiling?				
Whether meat was rare, or well done when served. Whether juicy or dry?				
How prepared next meal?				

II. SUPERVISOR FILLS OUT

Source				
Describe method of preparing				
Who prepared?				
From whom was method learned?				
Members of family not eating food				

Food Preparation

Schedule (d) Family No. ....

I. HOUSEWIFE FILLS OUT

COOKED VEGETABLES

DATE SERVED				
NAME OF VEGETABLE				
If fresh veg., young, average maturity, very mature				
Time started to prepare: washing, peeling, shelling, soaking, opening can				
If canned, was water drained off? If dried, was veg. soaked? Was veg. cooked in water in which soaked?				
Recipe (measures or weights)				
Container in which cooked. If steam pressure, give pressure used.				
Drained and more water added. Number times. Drained at end.				
Time vegetable put on stove?				
Time cooking complete?				
Time served?				
If interval, where kept until served?				
Was all pot liquor eaten? If not, give total no. cupfuls in all and no. cupfuls not eaten.				
Used next meal? If so, where and how stored? How prepared for next meal?				

Schedule (*d*) (Continued)

II. SUPERVISOR FILLS OUT

If home produced, when gathered and by whom?				
If purchased, when?				
Where and how had vegetable been stored in interval between gathering or purchasing and preparing?				
Parts discarded in preparation				
Was veg. soaked in water after being cut up before put on to boil? If so, how long? Kind of water soaked?				
Was veg. cooked whole, cut in halves, in quarters, in smaller pieces, shredded?				
Was veg. put on in boiling water or cold water, or in hot or moderate oven, or in hot or moderate grease?				
Was vegetable cooked with or without cover?				
When were seasonings added?				
Anything added to tender or to cook quicker?				
Who prepared vegetables?				
From whom was method learned?				
Members of family not eating vegetable				

Table a. Average number dishes served per family during record week of the type for which homemakers kept records.

Food type	Average number dishes served per family			
	White families		Negro families	
	Housing value $20.00 and under	Housing value $20.01-$40.00	Housing value $7.50 and under	Housing value $7.51-$20.00
Vegetable	11.3	11.4	8.6	10.7
Meat and eggs	10.3	14.0	9.7	10.1
Bread	9.6	8.7	12.2	12.4
Vegetable salad	1.0	1.3	0.4	0.5
Sliced tomato	6.4	6.1	1.5	1.8
Number of families	41	39	39	41

Food Preparation

Schedule (e) Family No. ....

I. HOUSEWIFE FILLS OUT

VEGETABLE SALAD

DATE SERVED				
NAME OF SALAD				
If veg. raw: young, average maturity, very mature				
Time started to prepare salad. Were veg. crisp or wilted?				
What use was made of water if canned veg. was used?				
Recipe (measure or weight)				
Time preparation complete				
If time between finished preparing and mealtime, how long; where was salad kept?				
Was it used at next meal? If so, where and how stored between meals?				

II. SUPERVISOR FILLS OUT

If home produced, when gathered and by whom?				
If purchased, when?				
Where and how had veg. been stored in interval between gathering or purchasing and preparing?				
Parts discarded in preparation				
Were vegetables cut or shredded with knife, grated, cut in meat chopper, shredded in shredder?				
Were vegetables soaked in water after being cut up?				
If potato salad, cooked with or without peelings; if without, was water discarded?				
Who prepared salad?				
From whom was method learned?				
Members of family not eating salad				

Table b. Foods for which preparation records were kept by homemakers in white and Negro families during report week classified by housing value.

Foods for which preparation records kept	White families		Negro families	
	Housing value $20.00 and under	Housing value $20.01-$40.00	Housing value $7.50 and under	Housing value $7.51-$20.00
	Number	Number	Number	Number
Total vegetables	245	217	200	218
Fresh vegetables:				
Irish potatoes	34	31	18	27
String beans	17	17	8	13
Butter beans	39	39	25	28
Field peas	35	26	34	30
Okra	20	29	12	20
Corn	24	23	20	26
Cabbage	4	3	22	21
Turnip greens	3	3	10	7
Tomatoes	6	7	4	4
Vegetable soup	9	3	8	3
Collards	0	0	6	8
Squash	3	6	2	1
All other	27	17	12	12
Dried vegetables	7	1	12	11
Peas and beans	7	1	12	11
Canned vegetables	17	11	7	7
Frozen vegetables	0	1	0	0
Total breads	68	66	87	91
Cornbread	37	33	43	46
Biscuit	25	24	41	43
Other breads	6	9	3	2
Total salads	48	42	22	33
Sliced tomato	23	16	13	23
Potato	6	8	5	5
Slaw	10	2	3	3
All other	9	16	1	2
Total meats and eggs	96	129	141	154
Eggs	32	62	38	47
Beef	20	21	24	21
Steak	12	5	6	4
Roast	2	5	1	2
Other	6	11	17	15
Sausage, weiners, and bologna	4	2	19	22
Variety meats	1	2	3	5
Bacon or salt pork	2	2	10	15
Ham or cured shoulder	6	5	6	8
Chicken	17	23	17	20
Fried chicken	14	20	15	16
Other	3	3	2	4
Fresh pork	9	6	22	11
Chops	7	5	11	3
Ribs	0	0	9	5
Roast	2	1	1	2
Other	0	0	1	1
Fresh fish	2	3	1	3
Salmon, canned	3	3	1	2

Table c. Food preparation ratings of white and Negro families and average number of cooking utensils of specified kind in usable condition owned.

Item	White families				Negro families			
	Food preparation rating group				Food preparation rating group			
	Good	Fair	Poor	Family having 1 or more	Good	Fair	Poor	Family having 1 or more
	Av. no.	Av. no.	Av. no.	Number	Av. no.	Av. no.	Av. no.	Number
Sauce pans or kettles	5.6	6.0	5.6	80	4.5	4.4	3.7	79
Double boiler or equiv.	0.7	0.8	0.7	57	0.8	0.7	0.8	54
Frying pans	2.8	2.8	2.6	80	2.2	2.3	2.2	79
Baking pans	3.5	2.7	2.5	76	2.4	2.5	2.3	78
Paring knives	1.6	1.1	0.8	64	0.5	0.5	0.3	30
Cutting knives	1.8	1.6	1.6	78	1.9	1.7	1.5	74
Muffin pans, no. of cups	12.1	9.7	11.3	70	5.2	5.4	6.6	56
Sifters	1.0	1.1	1.2	77	1.0	1.0	1.1	75
Measuring spoons	1.3	1.2	0.9	38	0.4	0.2	0.2	15
Measuring cups	1.1	1.0	0.8	57	0.6	0.4	0.3	31
Steam pressure cooker	0.3	0.3	0.3	23	0.1	*	0.0	3
Roasters	0.8	0.7	0.6	49	0.4	0.3	0.3	27

*One owned.

Table d. Food preparation rating of white and Negro families and kitchen storage facilities.

Kitchen storage facilities*	White families				Negro families			
	Food preparation rating group				Food preparation rating group			
	Good	Fair	Poor	Families having	Good	Fair	Poor	Families having
	Percent	Percent	Percent	Number	Percent	Percent	Percent	Number
Kitchen closet or pantry	33.3	38.9	27.8	35	36.3	45.5	18.2	11
No kitchen closet or pantry	33.3	26.7	40.0	45	23.2	46.4	30.4	69
Built-in kitchen cabinet	26.3	42.1	31.6	38	42.9	35.7	21.4	14
No built-in kitchen cabinet	40.5	23.8	35.7	42	21.2	48.5	30.3	66
Other kitchen cabinet	34.1	34.1	31.8	44	21.6	46.0	32.4	37
No other kitchen cabinet	33.3	30.6	36.1	36	27.9	46.5	25.6	43
Kitchen safe	26.3	21.1	52.6	19	20.8	41.7	37.5	24
No kitchen safe	36.1	36.1	27.8	61	26.8	48.2	25.0	56
Storage outhouse or cellar	46.7	36.7	16.6	30	26.3	42.1	31.6	19
No storage outhouse or cellar	26.0	30.0	44.0	50	24.6	47.5	27.9	61
None of storage facilities above	—	—	—	1	25.0	41.7	33.3	12
Kitchen closet or pantry and 1 or more other facilities	34.2	42.1	23.7	38	—	—	—	9

*Five white families and 2 Negro families had other storage, such as a shelf above a table. Percentages are not given where less than 10 families.

BULLETIN 434 APRIL 1946

The Vitamin A Potency of Creamery Butter Produced In Mississippi

By F. H. HERZER AND MARVIN GIEGER

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THE VITAMIN A POTENCY OF CREAMERY BUTTER PRODUCED IN MISSISSIPPI

By F. H. HERZER and MARVIN GIEGER

The Food and Nutrition Board of the National Research Council, in making wartime food recommendations, recognized that a seasonal variation in the vitamin A potency of milk and butter existed. While previous studies have disclosed many fundamental facts regarding the vitamin A content of butterfat, the actual variation of this substance in the butter offered the consuming public in the various sections of the United States at different seasons of the year was not known. A nation-wide study to learn these facts was recommended by the Bureau of Dairy Industry and the Office of Experiment Stations. To date the Experiment Stations of 19 states have participated in this project. The Mississippi Station began its first studies in March 1943.

An appraisal of the actual contribution which dairy products make to the national requirements was suggested by Palmer and Jenness, who estimated that the total vitamin A potency in the milk and milk products consumed in the United States is adequate to supply the vitamin A needs of 42,000,000 people. If by conserving the carotene in hays and silages and developing winter grazing, the vitamin A potency of winter milk could be increased to that of average summer milk, the vitamin A requirements of 11,000,000 more people could be satisfied. This would mean that 40 percent of the total units now considered essential in the human diet would be contributed by the dairy industry.

Since the vitamin A potency of milk depends upon the carotene content of the feeds consumed by the cow, conditions which are conducive to fresh growing pasture grasses, properly cured hay, and preserved silage, will enhance the vitamin value of the milk and at the same time stimulate production. Unquestionably, a higher vitamin A potency of milk and butter can be secured immediately and economically through better pasture management and the proper care of cured roughages.

Methods

Samples of butter were secured from three creameries located within a radius of 25 miles. These plants make about 60 percent of the butter manufactured in Mississippi. The samples selected by these plants represented butter of three general types, namely: that made from cream separated on the farm and delivered sweet to the creamery, designated as A; that from cream separated on the farm and held in most instances until sour before delivery to the plant, designated as B; and that from sweet cream secured by separating sweet milk at the plant, designated as C.

Much of the cream delivered to creamery A averaged 0.18 to 0.25 percent acidity. This cream was heated to 160° F. by a steam jet and agitated in a coil pasteurizer for 30 minutes at 155° F. before cooling to churning temperature. The bulk of this cream was churned within 1 or 2 hours after pasteurization.

The butter used in this project from creamery B was made from sour cream ranging in acidity from 0.5 to 1 percent, much of which originated with smaller shippers and cream stations scattered throughout the State. This was neutralized with sodium carbonate and sodium bicarbonate to approximately 0.25 percent acidity, forewarmed to 90° F. and flash pasteurized at 210° F. in a high temperature vacuum-type unit. As the hot cream sprayed into the vacuum compartment the temperature dropped to 140° F. This cream was immediately cooled to churning temperature over a surface cooler, held from 1 to 2 hours, and churned.

The cream used by creamery C was secured by separating fresh milk delivered to the plant. This cream had a very low acidity of 0.10 percent to 0.12 percent and was heated to 155° F. in a coil vat, pasteurized and held for 30 minutes before being cooled to churning temperature in the vat.

One pound samples of butter were secured from these creameries the first of each month. Analyses for carotene, vitamin A, and composition, (moisture, salt, curd, and butterfat) were made immediately. The butter was held in a 45° to 50° F. refrigerator to simulate storage conditions in the retail store and home refrigerator. At the end of 15 days and 30 days storage the same analyses were made. Since much of the butter produced in April, May, and June goes into cold storage, additional one-pound samples were stored at 0° F. for 5 months. This butter was then placed in a 45° F. storage, analyzed immediately and after storage for 15 days and after 30 days, to learn what effect, if any, storage and marketing routine might have on the vitamin A content.

Analytical Methods

The antimony trichloride method of determining vitamin A was used, the procedure being that of Koehn and Sherman.[1] Crystalline vitamin A alcohol (Distillation Products, Inc., 755 Ridge Road West, Rochester, New York) was used for vitamin A, Standard.

EXPERIMENTAL

Effect of Season

Approximately twice as much butter was made during the months of May, June, July, and August as in December, January, February, and March. This is shown in table 1 which lists the percentage of years' production of creamery butter manufactured each month during the year period from 1940 to 1944.

A statistical study of the analyses showed that there was no significant change in carotene and vitamin A content of the butter during the 15- and 30-day holding periods. All analyses of the nine samples of butter examined each month were therefore averaged in establishing the seasonal trend. The monthly variation in International Units of vitamin A per pound of butter throughout the year is shown in table 2 and graphically presented in figure 1.

A high level of vitamin A potency continued through July, August, September, and October 1943 and was resumed during April, May, and June of 1944. During these months the samples of butter averaged 18,230 International Units per pound. Since these values are probably representative of the entire State's make, approximately 70 percent of the annual butter production would be expected to contain a relatively high vitamin A potency.

The lack of feed of high carotene content such as properly preserved silage, high grade hay, fall and winter cover crops, is reflected in the lower levels reached during November, December, January, February, and March. During these months the total vitamin A potency averaged slightly over 12,000 International Units, the lowest level of 10,128 Units being reached in February.

With the appearance of pasture grasses and clovers some increase in vitamin A content is shown on March 1st, however, the effect of a plentiful supply of green feed is shown by the increase to 18,860 International Units on April 1st.

The carotene content of the butter reached both higher and lower levels than the vitamin A, ranging from 1.55 in March to 7.86 micrograms per gram of butter in August. The vitamin A content remained between the rather narrow limits of 4.42 on February 1st and 7.5 micrograms per gram of butter on

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[1] Koehn, C. J. and Sherman, W. C. The Determination of Vitamin A and Carotene with a Photoelectric Colorimeter. Jour. Biol. Chem., 132: 527-538. 1940.

Table 1. Mississippi butter production, 1940-1944, percentage by month.

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5.13	5.14	6.08	8.38	11.81	11.05	11.43	11.25	9.22	8.09	6.79	5.63

Table 2. Monthly average carotene, vitamin A and total vitamin A potency per pound of butter from three Mississippi creameries.

Production period	Carotene mcg./gm.	Vitamin A mcg./gm.	Vitamin A potency per pound, International Units
July 1943	7.70	6.15	17,812.4
August	7.86	6.35	18,325.0
September	7.35	6.34	17,921.6
October	5.92	6.40	16,955.2
November	5.33	5.24	14,252.1
December	3.49	5.08	12,546.6
January 1944	3.09	5.00	12,088.4
February	2.00	4.42	10,128.8
March	1.55	5.33	11,557.8
April	5.60	7.50	18,860.6
May	7.76	6.90	19,323.3
June	7.40	6.57	18,407.0

Table 3. Effect of one month's storage at 45° F. on the carotene and vitamin A content of butter.

Month	Carotene content after			Vitamin A content after		
	0 days mcg./gm.	15 days mcg./gm.	30 days mcg./gm.	0 days mcg./gm.	15 days mcg./gm.	30 days mcg./gm.
July	7.3	8.1	7.7	6.3	5.8	6.3
August	7.6	7.9	8.1	6.6	6.4	6.0
September	8.2	7.5	6.3	5.9	6.2	6.8
October	6.3	5.1	6.4	6.6	6.1	6.4
November	5.7	5.7	4.7	5.4	5.2	5.2
December	3.8	3.2	3.5	5.2	4.8	5.1
January	3.7	2.7	2.8	5.3	4.8	4.6
February	2.7	1.8	1.8	4.5	3.2	4.5
March	1.6	2.0	1.0	5.2	5.6	5.2
April	5.0	5.8	6.0	7.2	7.5	7.6
May	7.3	8.2	7.8	7.1	7.1	6.4
June	7.5	7.6	7.2	6.6	6.7	6.3
Average	5.56	5.47	5.28	6.0	5.78	5.87

April 1st. The vitamin A recovered from its downward trend March 1st, one month earlier than the carotene. However the carotene increased from 1.55 on March 1st to 5.6 on April 1st, which was the greatest spread between any two months of either material. During the months of low carotene intake, namely November, December, January, February, and March, approximately 20 percent of the total vitamin A potency was furnished by carotene, while during the remainder of the year 30 percent was supplied by carotene.

Effect of Short Storage

The values in table 3 are based on the average carotene and vitamin A content of the butter from the three creameries for the first, fifteenth, and thirtieth of each month. This butter was held in a 45° to 50° F. refrigerator in quarter-pound prints, and storage corresponded to retail store and home refrigerator conditions. The data presented indicate that both carotene and vitamin A were very stable.

Statistically, the variation in carotene and vitamin A due to 15- and 30-day

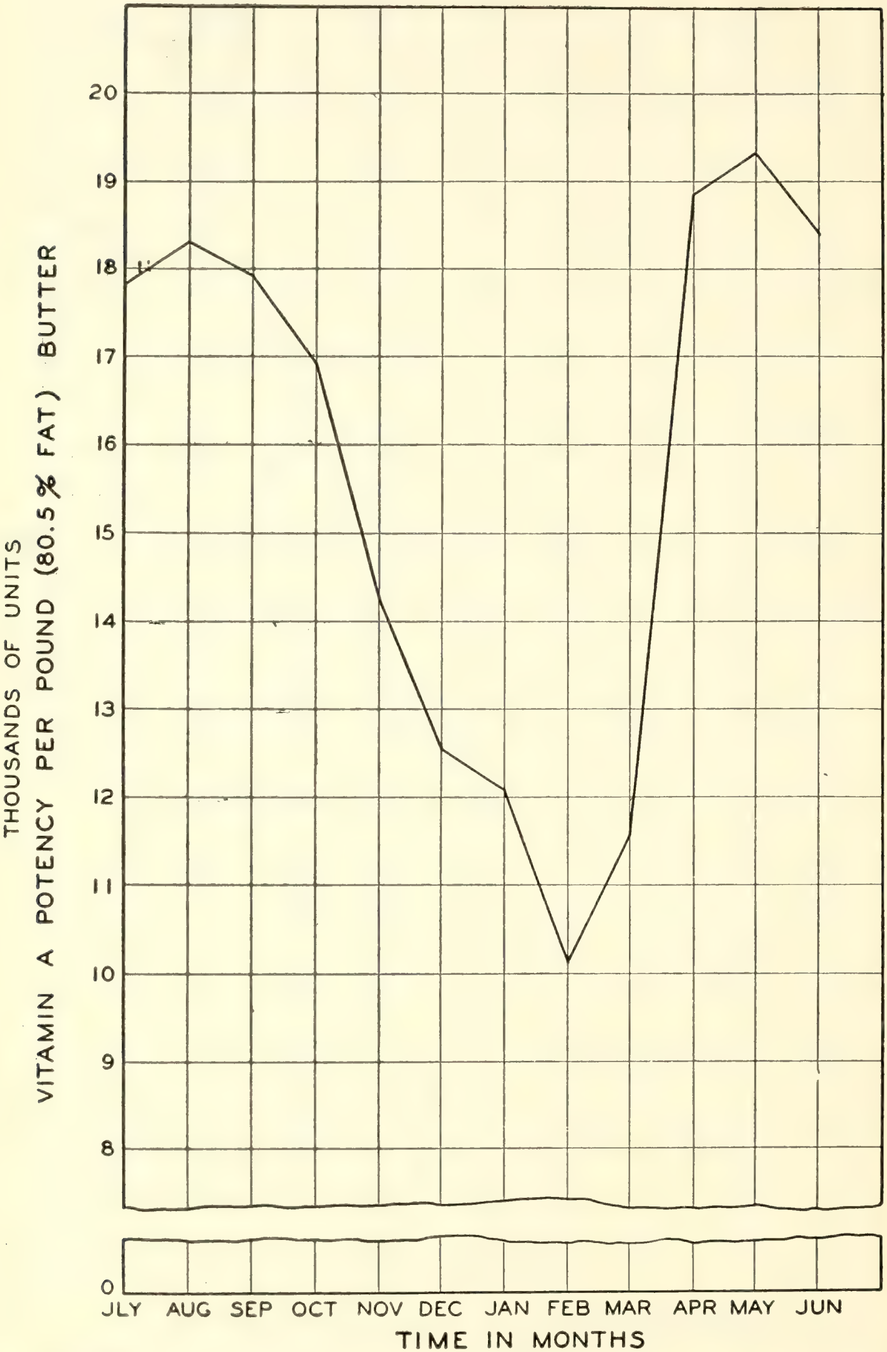

Figure 1. Seasonal variation of total vitamin A potency of the butter from three Mississippi creameries.

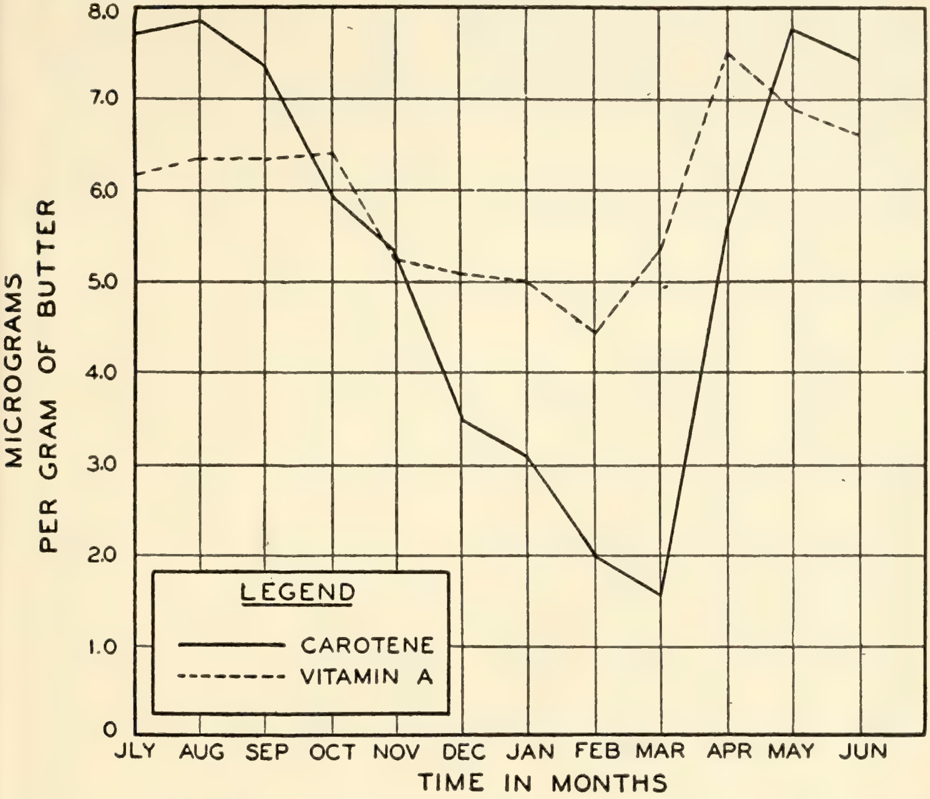

Figure 2. Seasonal variation of carotene and vitamin A in butter from three Mississippi creameries.

storage was not significant. F values for the 15- and 30-day storage periods were 1.00 for vitamin A and 0.51 for carotene. To be statistically significant at odds of 20 to 1, the F value for either carotene or vitamin A would need to exceed 3.11. On numerous sequences the 15- or 30-day storage samples were higher in carotene or vitamin A than fresh butter. These disturbing results have been reported by other Stations and at this time are not explainable.

No trends were established which indicated any deterioration in the vitamin potency due to holding for one month at 45° to 50° F.

Effect of Long Storage

Much butter goes into cold storage during the season of greatest production. This butter is generally held at 0° to -10° F. for 3 to 6 months and is then brought out during seasonal shortage, whereupon it follows the ordinary marketing channels at relatively high temperatures. Additional samples of butter were secured during April, May, and June from the same churnings used in the original tests. These samples were held in a 0° to -10° F. storage room for 5 months, then removed and placed in a 45° F. refrigerator. This butter was analyzed on the 1st, 15th, and 30th day after removal from the low

Table 4. Effect of 5 month's storage at 0° to -10° F. on carotene and vitamin A content.*

	Carotene after		Vitamin A after	
	No months	5 months	No months	5 months
Month	ug./gm.	ug./gm.	ug./gm.	ug./gm.
April	5.0	5.8	7.26	7.34
May	7.3	8.8	7.15	7.00
June	7.5	7.6	6.62	6.75
Average	6.6	7.4	7.01	7.03

temperature room, and the data are presented in table 4.

From the data obtained, no trend indicating that the carotene or vitamin A decreased due to storage at 0° F. or during the succeeding 30-day holding period at 45° F. was established.

The average values secured for the carotene and vitamin A after 5 months storage were actually higher than the original samples. While there were a few tests which might be questioned, most determinations were within the range of experimental error and indicate that the carotene and vitamin A were not adversely affected by 5 months storage at 0° F.

Effect of Holding Cream

Of interest was the somewhat lower potency of the butter from creamery B, the source of the sour cream butter. Although the three creameries in the study were located in the same immediate territory, a study of the data showed a significantly lower carotene and vitamin A content in the butter from this one plant.

While the higher acidity in the cream used in making the samples of butter secured from creamery B might be expected to minimize any reduction in vitamin A potency, a series of tests was conducted to learn if holding cream at fairly high temperatures with accompanying high acid, yeast and mold development, and partial neutralization, might have some influence.

Five tests were completed wherein fresh cream was collected directly from the separator, divided into five lots, and made into butter after different holding periods. Lot 1 was churned immediately without pasteurizing. Lot 2 was pasteurized at 155° F. for 30 minutes, cooled and churned. The remaining lots were held at room temperatures, neutralized, pasteurized and churned at 3-day intervals.

Some of the samples held at 80° to 90° F. developed a very high acidity (1 percent to 1.9 percent) and a yeasty moldy condition. Although the butter was not held for a prolonged storage period, much of the butter made from sour cream partially neutralized was actually in storage for several weeks before being analyzed. An examination of table 6 shows that while there was the same fluctuation in the carotene and vitamin A content experienced in some of the other tests, no significant reduction in vitamin A potency was recorded in the sour cream butter. Since feed and pasture conditions are quite similar in the territory immediately surrounding these plants, the fact that creamery B received cream from direct shippers and cream stations located in various parts of the State possibly not so favored with satisfactory pasture, offers the most logical explanation. The most noticeable spread between the three butters, occurs in the fall and winter months, when many small dairymen make little effort to supply a high quality roughage for their cows.

Table 5. Comparison of carotene, vitamin A and total vitamin A potency of butter from three creameries.

Production period	Carotene mcg./gm.			Vitamin A mcg./gm.			Total vitamin A potency per pound, International Units		
	Creamery			Creamery			Creamery		
	A	B	C	A	B	C	A	B	C
July 1, 1943	7.3	7.1	7.5	5.9	6.6	6.4	17143	18341	18230
August 1	7.7	7.1	8.0	6.4	6.9	6.6	18303	18878	18873
September 1	7.8	7.7	9.2	5.9	5.8	6.2	17484	17079	18981
October 1	7.0	5.2	6.6	6.6	6.6	6.6	18100	16831	17913
November 1	6.1	5.2	5.7	5.8	5.1	5.4	15922	13952	14845
December 1	3.8	3.5	4.0	5.5	4.9	5.3	13549	12311	13388
January 1, 1944	3.7	2.6	4.9	5.2	5.0	5.7	12970	11676	14780
February 1	3.1	2.0	2.0	4.9	4.0	4.6	11887	9292	10569
March 1	2.4	1.2	1.2	6.8	3.7	5.3	14638	8229	11178
April 1	6.0	4.2	4.8	7.3	7.2	7.2	18820	17259	17753
May 1	7.9	6.5	7.4	7.4	6.9	7.1	20393	18434	19528
June 1	7.3	7.5	7.6	6.5	6.5	6.8	18165	18429	19137

Table 6. Effect of holding cream on carotene and vitamin A content of butter.

Production period	Initial acidity	Acidity after neut.	Condition of cream	Temp. held	Condition of pasture	Age of cream	Carotene mcg./gm.	Vitamin A mcg./gm.
Test 1								
8/8	.11	—	Sweet	80-85°	Green	Fresh	8.85	7.52
8/8	.11	—	Sweet	80-85°	Green	Fresh	10.36	7.78
8/11	.93	.25	Sour, yeasty, moldy	80-85°	Green	3 days	11.39	7.66
8/14	1.40	.21	Sour, yeasty, moldy	80-85°	Green	6 days	7.61	7.62
8/17	1.90	.22	Sour, yeasty, moldy	80-85°	Green	9 days	8.70	7.44
Test 2								
8/25	.10	—	Sweet	80-85°	Green	Fresh	8.90	7.66
8/25	.10	—	Sweet	80-85°	Green	Fresh	9.20	7.72
8/28	.90	.25	Sour, yeasty, moldy	80-85°	Green	3 days	10.35	7.37
8/31	1.20	.30	Sour, yeasty, moldy	80-85°	Green	6 days	9.36	8.37
9/4	1.90	.35	Sour, yeasty, moldy	80-85°	Green	9 days	9.05	7.89
Test 3								
10/13	.10	—	Sweet	60-70°	Dry	Fresh	6.38	5.99
10/13	.10	—	Sweet	60-70°	Dry	Fresh	6.80	6.16
10/16	.70	.30	Sour, yeasty, moldy	60-70°	Dry	3 days	6.52	5.97
10/19	.80	.31	Sour, yeasty, moldy	60-70°	Dry	6 days	6.82	6.22
10/22	.85	.25	Sour, yeasty, moldy	60-70°	Dry	9 days	6.59	6.12
Test 4								
11/14	.10	—	Sweet	55-65°	Dry	Fresh	2.80	3.69
11/14	.10	—	Sweet	55-65°	Dry	Fresh	2.61	3.50
11/17	.65	.25	Sour, yeasty, moldy	55-65°	Dry	3 days	2.59	3.68
11/21	.85	.20	Sour, yeasty, moldy	55-65°	Dry	6 days	2.76	3.68
11/24	.95	.25	Sour, yeasty, moldy	55-65°	Dry	9 days	3.09	3.49
Test 5								
Unpasteurized cream								
12/20	.08	—	Sweet	45-60°	Dry	Fresh	3.65	6.13
12/23	.30	—	Sour	45-60°	Dry	3 days	3.46	6.12
12/27	.75	—	Sour	45-60°	Dry	6 days	3.69	6.24
12/30	.79	—	Sour	45-60°	Dry	9 days	3.60	6.36

The Effect of High Temperature Pasteurization on Vitamin A Potency

A high temperature vacuum type paseurizer was used by creamery B in proessing the cream for butter making. Orinarily the cream was neutralized with odium carbonate and sodium bicarbonte to between 0.2 percent and 0.3 perent acidity in a forewarmer. It was

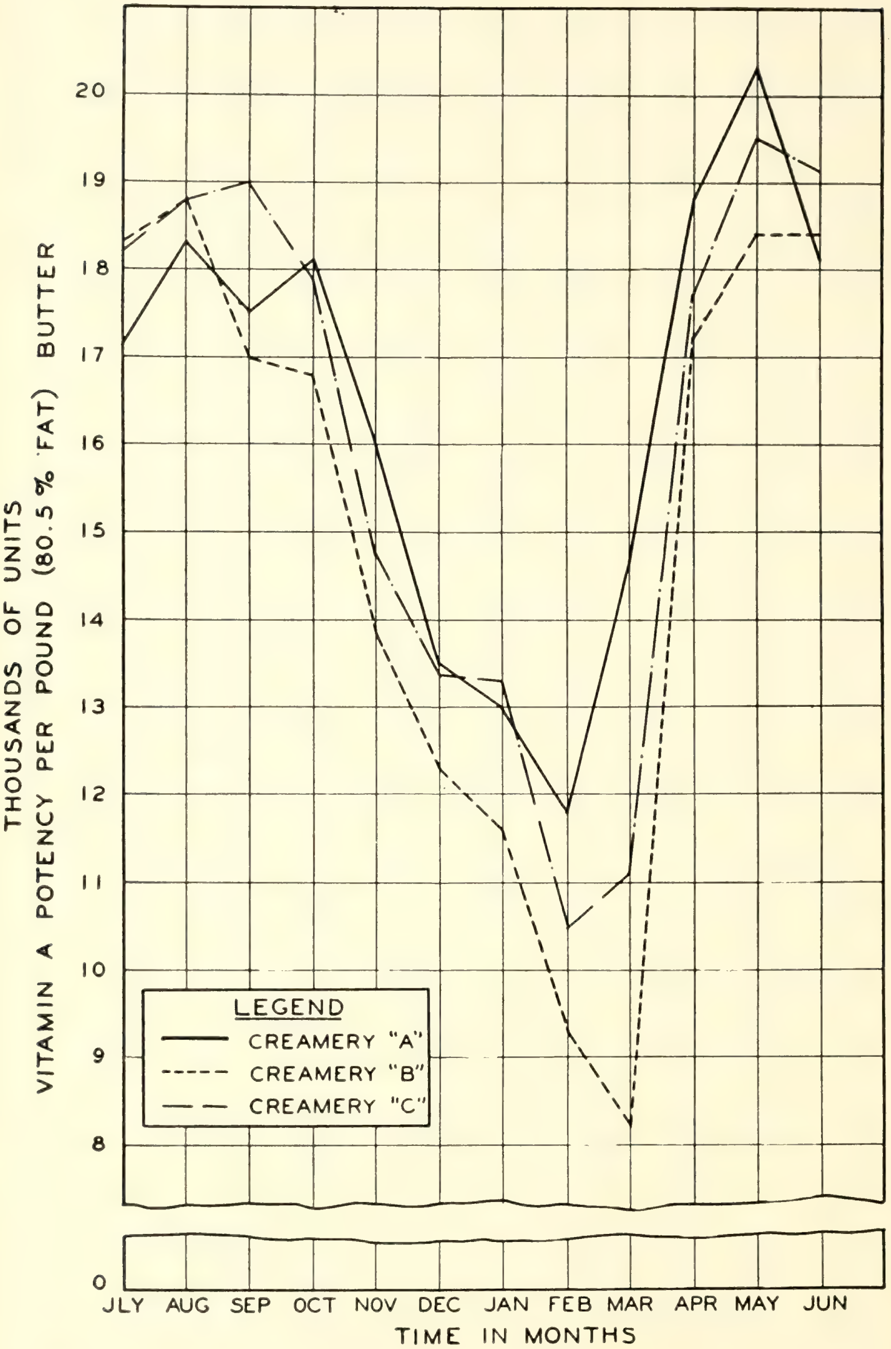

Figure 3. Seasonal vitamin A potency of butter from three Mississippi creameries.

then heated to 90° F. before entering the pasteurizer. The cream was subjected to a steam jet which heated it to 200° to 215° F, then quickly sprayed into a vacuum pan where the temperature dropped to approximately 140° F. This cream then passed over a surface cooler and was cooled to churning temperature. Four check tests were made to learn if this particular process had any effect upon the vitamin A potency of the resulting butter. Samples of the raw cream were taken from the forewarmer before treatment and again off the cooler after being completely processed. The samples of cream were churned and the butter analyzed. The results of this brief study recorded in table 7 indicate that this method of processing had no effect upon the carotene or vitamin A content of the butter studied.

Table 7. Effect of high temperature pasteurization on the vitamin A potency of butter.

		Raw	Pasteurized	Raw	Pasteurized
Production Period	Sample number	Carotene mcg./gm.	Carotene mcg./gm.	Vitamin A mcg./gm.	Vitamin A mg./gm.
April 16, 1945	1	9.76	10.12	8.28	8.71
	2	10.78	10.67	8.68	8.52
May 1, 1945	3	9.41	10.33	6.91	6.79
	4	10.86	10.42	7.38	7.43
Average		10.20	10.38	7.81	7.83

Summary

1. The butter analysed in this study ontained approximately 18,000 International Units of vitamin A per pound from April to October inclusive. The butter examined from November through March contained an average of approximately 12,000 International Units per pound.

The similarity of the vitamin A content of butter produced in Mississippi to the national average as determined from results secured by the 19 participating states is most striking. The U. S. Department of Agriculture Miscellaneous Publication No. 571, "Vitamin A in Butter," records that the summer butter averaged 18,000 International Units of vitamin A per pound while winter butter contained approximately 11,200 units per pound.

2. Approximately seventy percent of the butter made in Mississippi is produced during the months of high vitamin A potency.

3. Holding the butter at 45° F. for one month did not lower the carotene or vitamin A content.

4. Holding the butter at 0° F. for 5 months followed by 30 days storage at 45° F. did not lower the carotene or vitamin A content.

5. The development of varying acidities in cream and subsequent neutralization before pasteurization did not lower the carotene or vitamin A content.

6. The use of high temperature vacuum type of pasteurization did not affect the carotene or vitamin A content.

7. The carotene content of the butter examined showed a much greater seasonal variation than the vitamin A content.

Discussion

The contribution of vitamin A through the medium of dairy products is of major nutritional importance to the consuming public. Figure 1 shows that the lowest level of vitamin A potency of milk products occurs in the winter months when other foods comprising the human diet are also low in vitamin A. It would be most desirable if the vitamin A content of winter butterfat could be held at a higher level.

Koehn, of the Alabama Station found

that the milk from cows placed on a temporary pasture of Abruzzi Italian rye, crimson and white Dutch clover in February, increased in 2 weeks time to a vitamin A content equal to that of good summer milk and remained at that level until the permanent pastures were ready for spring grazing. An equal increase in vitamin A can be expected from the grazing of any other growing cover crop.

Oats, wheat and vetch, in particular, have become popular in many sections of Mississippi. The Dairy Department of Mississippi State College used a mixture of 1½ bushels oats, ½ bushel wheat, and 15 pounds vetch to the acre; more recently the amount of seed has been increased to 2 bushels oats, 1 bushel wheat, and 15 pounds vetch.

While, from the standpoint of the nutritionist, this increase in vitamin A in dairy products is of particular importance, the actual benefits of direct value to the dairyman extend far beyond the improvement in the quality of milk.

Financial Returns

Numerous tests run by the Mississippi Station have shown that grazing winter cover crops is profitable, and consequently cover crops grazing has been practiced by the Dairy Department for the past 20 years. In a specific test reported by J. S. Moore in the December 1943 Farm Research, 12 acres were disked and planted to oats and vetch in September. By November 10th there was a stand of oats averaging 8 to 15 inches in height. While the dairy herd was already on full winter ration, 52 cows and 18 heavy springers were turned on this field for 15 days. The yield of milk increased 16.3 precent the first week and 24.6 percent during the second week. The value of the increased production, together with silage saved and $31.50 credit for the physical improvement of the springers, were given a minimum estimate of $176.55 that could be attributed to the first 15 days grazing. Ordinarily one or two more grazing periods can be expected depending upon the season.

Feed

Moore reports another test wherein 80 to 90 acres were planted to a mixture of oats, wheat and vetch. By the end of December sufficient grazing had been obtained from these crops to pay all costs of seed, preparation of land, and planting. One field was not grazed after January 1st. The seed was allowed to ripen and the crop was harvested for feed, yielding 1,678 pounds of grain and 2,425 pounds of straw per acre. To secure this same feed value from corn as a grain crop would require a yield of about 30 bushels of corn per acre. The winter grazing crop was grown when the land would otherwise have been idle, required no work after planting, and furnished a good cover crop which protected the soil from erosion during the winter months. A yield of 1¼ tons of hay per acre was secured after fall and early spring grazing. This crop was removed early enough to plant corn. Where the grain was allowed to mature it was followed with sorghum for silage, sagrain for grain or silage, and soybeans for hay.

Green Manure

In the above test a portion of the crop was disked in for soil building. This was done on March 24th, after taking the cows off on March 15th, and amounted to about 5,645 pounds of green manure to the acre. Some of the phosphorus and potash of the soil was probably conserved and changed to a more easily assimilated form, and it was estimated 16½ additional pounds of nitrogen were added to the soil together with organic matter. This organic matter improves the physical condition of the soil, permits greater infiltration of rainfall, and prevents or greatly diminishes soil loss due to water erosion at the most critical period of the year.

Erosion

Russell Woodburn reports that tests at the Mississippi Station show an average loss of 83 tons of soil per acre on a bare plot on a 9 percent slope over a 3-year period. A maximum loss of 141 tons per acre or almost one inch of soil occurred in 1944 due to the severe rainfall. A cotton plot nearby on a slope of 10 percent. with winter vetch cover, lost 25 tons per acre in 1944. This loss was almost entirely during the cotton season from April 1 to October 1. Of further interest is the fact that turning under vetch on other experimental plots permitted ten times more soil loss during the 1944 cotton season than disking in. While the plot having the disked vetch lost 2.3 tons of soil per acre from April to October, the bare plot lost 83 tons during the same period.

Physical Condition of the Cow

Kuhlman, of the Oklahoma Station, states that many dairy cattle in the South receive rations so low in carotene that normal functional performance cannot be attained. This is due to the feeding of large quantities of low grade hay, cottonseed hulls, and lack of good silage. The Oklahoma Station states that 40 to 45 micrograms of carotene per pound body weight is about the minimum amount which will meet the daily requirements of cows of the Jersey breed, permit normal calving and the initiation of a normal lactation period. When the carotene intake fell below this point during the last 90 days before calving, many of the calves were either dead or very weak at birth, the cows developed symptoms of vitamin A deficiency, and some indication of a shortened gestation period was noted.

Acknowledgments

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BULLETIN 435 MAY 1946

Cotton Variety Tests
in the
Yazoo-Mississippi Delta
1943-45

By

J. Winston Neely *and* Sidney G. Brain

Delta Branch Experiment Station, Stoneville

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

Cotton Variety Tests in the Yazoo-Mississippi Delta, 1943-45

By J. WINSTON NEELY and SIDNEY G. BRAIN
Delta Branch Experiment Station, Stoneville

For many years the Delta Branch Station has been testing varieties of cotton at Stoneville and on selected plantations in other representative sections of the Yazoo-Mississippi Delta in an effort to evaluate the performance of the various cottons under as nearly as possible the same conditions that they are to be grown by Delta planters.

It has been the policy of the station to adapt the variety tests to the current needs of producers, buyers, spinners, weavers, and oil-mill operators for information relative to the characteristics of varieties. During the time that the boll weevil was first becoming a factor in production, information was obtained regarding the relative boll-weevil tolerance of cotton varieties because of earliness. When pathogenic wilt became a production factor in some parts of the Delta, information was provided regarding the relative wilt resistance of the different varieties.

At the present time cotton mills are paying a great deal of attention to tensile strength of fiber and fiber length uniformity, since these characteristics, along with length, give an indication of the resulting manufacturing quality of the cotton. The current report is the third from the Delta Station in which tensile strength of fiber and fiber length uniformity for each of the varieties grown at each of the locations have been reported.

As additional information relative to the characteristics of cotton varieties is required, the tests will be planned to supply as much of this information as possible.

During the past 3 years, the following characteristics of the most commonly planted varieties have been determined: (1) Yield of seed cotton, (2) yield of lint, (3) gin turn-out, (4) staple length, (5) size of boll, (6) earliness, (7) fiber tensile strength, (8) length uniformity of fiber, and (9) money value per acre.

The yields of seed cotton are based upon the weights harvested from ten, one-row plots at each location each season.

The yields of lint are based upon the respective yields of seed cotton and gin turn-outs.

Gin turn-out values were determined by ginning ten, 100-boll samples which were picked from each variety at each location during each of the three seasons.

The staple lengths of each variety at each location were determined by classers of the Staple Cotton Cooperative Association, Greenwood, Mississippi, and of the Greenwood office of the Board of Cotton Examiners, Production and Marketing Administration, of the U. S. Department of Agriculture.

The sizes of boll are based upon the average weight of ten, 100-boll samples from each variety at each location.

The percentage of cotton obtained from the first picking, which is considered a measure of earliness, was determined by dividing the weight of the first picking by the weight of the total production.

The fiber tensile strength and the length uniformity of fiber were determined in the Stoneville Fiber Laboratory of the Production and Marketing Administration.

The money values per acre are based upon: (1) Yields of seed and lint, (2)

Table 1. Stoneville cotton variety test, 1945.

Variety	Yield per acre		Gin turnout	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	2872	948	33.0	35.7	67.5	33.4	83,600	83.0	304	291	252
Bobshaw 1	2928	1016	34.7	34.9	66.5	27.1	82,800	82.7	310	293	261
Coker 100-9	2865	1043	36.4	36.2	66.5	23.9	81,800	80.0	341	312	266
Coker 100-Staple Str. 1	2821	990	35.1	36.6	65.0	22.9	78,900	80.3	335	306	257
Delfos 444	2975	890	29.9	36.9	78.9	23.2	74,500	79.7	320	292	244
Delfos 531C	2601	843	32.4	37.0	74.7	33.6	78,300	78.9	303	277	230
Delfos 651	2659	877	33.0	36.9	72.6	34.4	77,400	79.7	313	285	238
Delfos 9169	2947	1020	34.6	36.3	63.5	28.2	78,000	80.5	345	317	269
Deltapine 14	2668	1025	38.4	34.9	71.4	22.4	77,700	83.6	308	290	254
Miller	3010	1072	35.6	32.8	59.3	25.9	76,900	85.5	309	296	264
Stoneville 2B	3049	1061	34.8	35.6	60.7	23.7	82,800	82.1	341	316	275
Wilds 17	2319	730	31.5	40.6	64.7	17.2	89,900	81.3	300	271	204
Dif. barely significant	204	73	.7	.6	1.9	4.8	1,700	1.8	26	24	19
Dif. highly significant	270	97	.9	.8	2.6	6.4	2,300	2.4	35	32	25

staple lengths, and (3) seed grades. The values for three grades—Middling, Strict Low Middling, and Low Middling—are given. The average prices for cotton of the respective grades and several lengths for 10 weeks of the 1945 marketing season in Memphis were used. The seed were evaluated on a basis of $56 per ton, with premiums and discounts in accordance with official standards for grading cottonseed set up by the U. S. Department of Agriculture. The seed analyses were made in the Stoneville Laboratory of the Production and Marketing Administration of the U. S. Department of Agriculture.

The current report is divided into two parts: (1) The 1945 tests, and (2) the 1943 to 1945 tests.

Results of the 1945 Tests

During the 1945 season the Delta Branch Experiment Station conducted cotton variety tests at the following locations in the Yazoo-Mississippi Delta: Stoneville, Jonestown, Money, Heathman, Valley Hill, Yazoo City, and Kelso.

Excessive amounts of rainfall during the planting, growing, and harvesting seasons occurred at all locations.

Stoneville Test

The Stoneville test was located at the Delta Branch Experiment Station and was conducted in cooperation with the late J. W. Whitaker, county agent of Washington County. The soil is a sandy loam, typical of banks along upper Deer Creek. A nitrogenous fertilizer was "bedded on" about 2 weeks before planting. The test was planted on April 27. The first picking was made on September 18, and the second and third pickings were made on October 11 and December 7, respectively. Results of the 1945 Stoneville tests are given in table 1.

When comparisons are based upon Middling grade, the following varieties were leading money-value producers: Delfos 9169, Coker 100-9, Stoneville 2B, Coker 100-Staple Strain 1, and Delfos 444. If comparisons are made on the basis of Strict Low Middling grade, the leading varieties are Delfos 9169, Stoneville 2B, Coker 100-9, Coker 100-Staple Strain 1, Miller, and Bobshaw 1. The following varieties are leading money-value producers when comparisons are

Table 2. Jonestown cotton variety test, 1945.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1623	489	30.1	36.5	69.8	76.1	83,300	76.5	172	157	134
Bobshaw 1	1627	513	31.5	35.3	65.9	72.1	82,600	76.2	163	153	136
Coker 100-9	1158	395	34.1	36.5	72.4	79.2	81,900	71.3	131	120	101
Coker 100-Staple Str. 1	1419	468	33.0	37.1	70.3	70.9	80,900	72.2	164	149	123
Delfos 444	1365	366	26.8	37.4	79.2	75.9	74,400	73.6	138	126	104
Delfos 531C	1439	445	30.9	36.9	74.5	76.1	78,300	72.7	159	145	122
Delfos 651	1400	430	30.7	36.6	71.0	77.8	78,400	73.5	151	138	118
Delfos 9169	1591	522	32.8	35.9	63.9	72.3	77,400	74.4	173	160	139
Deltapine 14	1290	490	38.0	35.6	76.8	64.3	77,900	77.5	151	140	122
Miller	1564	533	34.1	33.1	58.5	65.8	77,000	77.8	155	148	132
Stoneville 2B	1373	450	32.8	35.5	62.2	67.7	80,400	75.0	144	135	118
Wilds 17	901	266	29.5	41.1	66.2	42.4	86,500	75.4	111	100	75
Dif. barely significant	185	62	.8	.5	2.0	6.7	2,000	1.7	21	19	16
Dif. highly significant	245	83	1.0	.7	2.6	8.8	2,700	2.3	28	25	21

made on the basis of Low Middling: Stoneville 2B, Delfos 9169, Coker 100-9, Miller, Bobshaw 1, and Coker 100-Staple Strain 1.

Jonestown Test

The Jonestown test was conducted in cooperation with Carey Cocke, Jr., farm operator, and Harris Barnes, county agent of Coahoma County. The test is located on the Eagle Nest Plantation west of Jonestown. The soil is a sandy loam and is well drained. A nitrogenous fertilizer was "bedded on" and the test planted on May 11. The first and second pickings were made on October 18 and February 21, respectively. The plants were rank. There was a light boll-weevil infestation and considerable boll rot. Pathogenic wilt killed a few plants but probably was of no consequence. There was some falling out of cotton between the first and last pickings, but very little difference in this respect between varieties was noted. The results of the tests conducted at Jonestown in 1945 are given in table 2.

The upper money value producing group includes Delfos 9169, Bobdel, Coker 100-Staple Strain 1, Bobshaw 1, Delfos 531C, and Miller when comparisons are made on the basis of Middling grade. Delfos 9169, Bobdel, Bobshaw 1, Coker 100-Staple Strain 1, Miller, and Delfos 531C are leading money-value producers in the Strict Low Middling comparisons. Delfos 9169, Bobshaw 1, Bobdel, Miller, and Coker 100-Staple Strain 1 lead in regard to money value per acre when comparisons are based upon the Low Middling grade.

Money Test

In cooperation with H. L. Gary, president of Wildwood, Incorporated, and J. S. McBee, county agent of Leflore County, a test was conducted near Money on the east banks of the Tallahatchie River. The soil is a fine, sandy loam and is well drained. A nitrogenous fertilizer was "bedded on" before planting. The test was planted on April 19. "Damping off" of seedlings resulted in irregular stands, but apparently none of the varieties were discriminated against because of poor stands. The first picking was made on September 28 and the second picking on November 23. The results of the 1945 Money tests are given in table 3.

Table 3. Money cotton variety test, 1945.

Variety	Yield per acre: Seed cotton	Yield per acre: Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Total money value: Mid-dling	Total money value: Strict Low Mid-dling	Total money value: Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1950	597	30.6	35.0	69.2	61.7	79,300	77.6	192	181	161
Bobshaw 1	2204	734	33.3	34.9	67.8	61.6	75,000	77.7	226	214	190
Coker 100-9	1977	700	35.4	35.4	68.7	58.7	76,400	75.2	216	201	177
Coker 100-Staple Str. 1	2141	728	34.0	36.1	67.9	56.3	73,100	74.9	239	220	189
Delfos 444	2301	656	28.5	35.7	75.4	62.4	68,300	75.0	223	208	182
Delfos 531C	2175	689	31.7	35.9	72.1	64.8	72,800	73.8	232	215	187
Delfos 651	2183	694	31.8	36.2	69.9	63.5	74,900	73.4	238	219	189
Delfos 9169	2014	677	33.6	35.4	60.3	65.4	73,900	75.8	217	202	178
Deltapine 14	1987	761	38.3	34.7	73.7	50.8	73,400	77.8	224	212	187
Miller	2086	738	35.4	32.8	60.9	57.6	70,200	79.9	214	205	182
Stoneville 2B	2323	783	33.7	35.0	60.8	60.1	76,800	75.8	241	228	203
Wilds 17	1547	463	29.9	39.9	66.6	47.3	83,800	76.9	188	170	131
Dif. barely significant	202	68	.6	.4	1.8	5.1	2,100	1.3	22	20	18
Dif. highly signifilant	268	90	.8	.6	2.4	6.7	2,800	1.7	29	27	23

Stoneville 2B, Coker 100-Staple Strain 1, Delfos 651, Delfos 531C, Bobshaw 1, Deltapine 14, and Delfos 444 lead the test in money value produced on the basis of Middling and Strict Low Middling comparisons. Stoneville 2B, Bobshaw 1, Coker 100-Staple Strain 1, Delfos 651, Delfos 531C, and Deltapine 14 are leading money-value producers in the Low Middling comparisons.

Heathman Test

The Heathman test, in Sunflower County, was conducted in cooperation with Roy Kuykendall, general manager

Table 4. Heathman cotton variety test, 1945.

Variety	Yield per acre: Seed cotton	Yield per acre: Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Total money value: Mid-dling	Total money value: Strict Low Mid-dling	Total money value: Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	2102	660	31.4	36.1	63.6	67.1	80,200	78.3	225	207	179
Bobshaw 1	2281	746	32.7	35.6	61.9	54.7	78,600	78.9	242	224	196
Coker 100-9	2199	774	35.2	36.3	64.1	59.5	79,000	76.3	255	234	198
Coker 100-Staple Str. 1	2522	847	33.6	37.6	61.4	53.2	75,300	78.2	305	277	224
Delfos 444	2608	759	29.1	37.2	69.3	61.4	70,900	78.7	282	257	213
Delfos 531C	2417	776	32.1	37.6	66.2	61.4	75,100	75.4	286	260	212
Delfos 651	2270	722	31.8	36.8	65.8	62.3	74,700	77.3	257	235	197
Delfos 9169	2343	790	33.7	36.4	56.7	60.5	75,300	77.8	269	246	210
Deltapine 14	2052	802	39.1	35.0	67.2	51.9	74,200	79.4	236	223	196
Miller	2144	765	35.7	33.0	54.4	55.9	75,000	81.2	221	212	188
Stoneville 2B	2373	795	33.5	36.0	56.6	59.5	77,700	76.1	263	242	210
Wilds 17	1767	523	29.6	40.9	63.3	51.5	85,900	76.3	218	196	147
Dif. barely significant	221	75	.6	.6	1.6	5.1	2,200	1.9	27	24	20
Dif. highly significant	293	99	.8	.8	2.1	6.7	2,900	2.6	36	32	26

of Bobshaw Chemurgic Plantation, and H. A. Carpenter, county agent. The field is located on Highway 82. The soil is a light colored, well drained, silt loam. A nitrogenous fertilizer was "bedded on" before planting. The test was planted on May 5. Stands were irregular due to "damping off," but apparently none of the varieties were discriminated against because of poor stands. Boll-weevil infestations were heavy. The first picking was made on September 24 and the second picking on November 28. The results of the Heathman test are given in table 4.

When comparisons were made upon the basis of Middling or Strict Low Middling grades, Coker 100-Staple Strain 1, Delfos 531C, and Delfos 444 were leading money-value-per-acre producers. Coker 100-Staple Strain 1, Delfos 444, Delfos 531C, Delfos 9169, and Stoneville 2B produced significantly higher money values per acre than did the other varieties when comparisons were based upon Low Middling grade.

Valley Hill Test

In cooperation with L. S. Hemphill, landowner, and R. A. Cooper, county agent, a test was conducted at Valley Hill in Carroll County about 6 miles east of Greenwood on Highway 82. The test is on the eastern border of the Delta. The surface soil is a light colored, well drained, silt loam made up of outwash from the hills. A nitrogeous fertilizer was "bedded on" before planting. The test was planted on May 23. An earlier planting on April 20 failed to give sufficient stands. Pathogenic wilt was very bad. Delfos 651, Delfos 444, Delfos 531C, Coker 100-Staple Strain 1, and Coker 100-9 were the most susceptible varieties. Miller and Bobshaw 1 were the most resistant varieties. Boll-weevil infestations were very heavy, and losses due to weevil were of some consequence, particularly in the late varieties. The test was picked on October 19. Earliness data are not available. The results of the 1945 Valley Hill test are given in table 5.

Delfos 9169, Bobdel, Miller, Bobshaw 1, and Coker 100-Staple Strain 1 were

Table 5. Valley Hill cotton variety test, 1945.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Fiber tensile strength	Fiber length uni-formity	Total money value		
	Seed cotton	Lint						Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1501	444	29.6	35.1	65.5	79,100	77.9	143	135	121
Bobshaw 1	1428	456	31.9	34.3	64.7	78,400	78.2	140	133	118
Coker 100-9	790	269	34.1	35.6	66.0	77,400	72.0	84	78	68
Coker 100-Staple Str. 1	1231	409	33.2	36.1	65.3	75,800	74.6	135	124	106
Delfos 444	1205	329	27.3	36.4	75.4	68,900	76.7	118	109	93
Delfos 531C	782	239	30.5	35.9	75.7	74,900	72.2	81	75	65
Delfos 651	973	298	30.6	35.9	68.8	76,100	74.8	101	93	81
Delfos 9169	1454	475	32.7	35.4	62.0	74,300	76.0	152	142	126
Deltapine 14	1006	377	37.5	35.0	73.1	75,500	77.8	113	106	93
Miller	1411	492	34.9	32.5	57.4	74,600	80.4	141	136	121
Stoneville 2B	1274	417	32.7	34.8	59.8	77,800	75.5	128	121	108
Wilds 17	873	254	29.1	39.8	66.2	87,200	75.3	99	90	69
Dif. barely significant	173	57	.7	.4	2.0	2,100	1.5	18	17	15
Dif. highly significant	228	76	1.0	.6	2.7	2,800	2.0	24	23	20

Table 6. Yazoo City cotton variety test, 1945.

	Yield per acre								Total money value		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1790	551	30.8	35.6	68.8	85.8	77,400	77.9	187	174	153
Bobshaw 1	1913	626	32.7	35.3	68.1	84.1	75,300	77.4	207	194	171
Coker 100-9	1644	579	35.2	35.9	70.6	85.0	76,500	76.1	187	173	149
Coker 100-Staple Str. 1	1888	648	34.3	36.5	68.5	83.5	73,200	76.9	214	196	164
Delfos 444	2091	594	28.4	36.4	76.7	87.5	69,400	77.8	204	188	160
Delfos 531C	1908	605	31.7	36.3	75.1	88.8	73,000	75.1	201	184	158
Delfos 651	1828	578	31.6	36.4	70.7	86.5	74,000	75.8	200	183	157
Delfos 9169	2017	670	33.2	35.4	64.0	86.8	73.400	75.7	213	198	174
Deltapine 14	1877	717	38.2	34.7	73.3	80.4	71,700	79.4	209	198	175
Miller	1795	623	34.7	32.9	61.2	80.8	69,600	80.9	177	170	152
Stoneville 2B	1903	632	33.2	35.5	61.8	87.9	77,200	75.7	200	187	164
Wilds 17	1377	410	29.8	40.1	64.8	82.2	85,000	76.4	185	167	128
Dif. barely significant	178	62	.7	.5	1.9	3.7	1,500	1.8	23	21	17
Dif. highly significant	235	82	1.0	.6	2.5	4.9	2,000	3.2	31	28	23

leading money-value producers when comparisons were made upon the basis of Middling grade.

When comparisons were made on the basis of Strict Low Middling or Middling grades, Delfos 9169, Bobdel, Miller, and Bobshaw 1 were leading money-value-per-acre producers.

Yazoo City Test

The Yazoo City test was conducted on the Marx Schaefer farm 3 miles west of Yazoo City in cooperation with Mr. Schaefer and with A. R. Ruby, county agent of Yazoo County. The soil is a fine sandy loam and is well drained. A nitrogenous fertilizer was "bedded on" and the test planted on April 12. There was considerable "damping off" of seedlings, but the stands were fairly good. The plants grew tall, and the foliage was very heavy. Boll rot and boll-weevil infestations were very bad. The test was picked on September 26 and again on November 29. Results of the Yazoo City test are given in table 6.

Leading money-value producers were Coker 100-Staple Strain 1, Delfos 9169, Deltapine 14, Bobshaw 1, Delfos 444, Delfos 531C, Delfos 651, and Stoneville 2B when comparisons are made on the basis of Middling grade. Delfos 9169, Deltapine 14, Coker 100-Staple Strain 1, Bobshaw 1, Delfos 444, Stoneville 2B, Delfos 531C, and Delfos 651 lead in regard to money value per acre when comparisons are based upon Strict Low Middling grade. When comparisons are based upon Low Middling grade, the following varieties were the leading money-value producers: Deltapine 14, Delfos 9169, Bobshaw 1, Coker 100-Staple Strain 1, Stoneville 2B, Delfos 444, and Delfos 531C.

Kelso Test

The Kelso test was conducted in cooperation with James Hand of Kelso Plantation and C. L. Cary, county agent of Sharkey County. It is located on the Sharkey-Issaquena county line 11 miles south of Cary on Highway 61. The soil is a sandy loam and is well drained. The test was planted in check rows on April 17. The rows were 40 inches apart each way. Six plants were left in each

Table 7. Kelso cotton variety test, 1945.

	Yield per acre							Total money value		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs	Pct.	1/32 in.	Bolls	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1385	414	29.9	35.4	70.0	75,100	76.3	135	127	112
Bobshaw	1439	435	30.2	34.7	68.2	73,300	77.6	137	130	116
Coker 100-9	1389	454	32.7	35.9	72.0	74,500	75.8	148	136	118
Coker 100-Staple Str. 1	1363	425	31.2	36.4	69.5	71,600	74.0	146	134	114
Delfos 444	1615	417	25.8	36.2	79.1	67,700	74.3	150	138	120
Delfos 531C	1483	430	29.0	36.3	73.6	70,800	73.5	152	140	121
Delfos 651	1468	421	28.7	36.1	72.9	71,300	74.2	147	136	118
Delfos 9169	1390	441	31.7	35.3	63.1	69,900	74.6	142	133	118
Deltapine 14	1179	428	36.3	35.2	74.7	70,700	77.6	130	122	108
Miller	1161	383	33.0	32.9	63.3	68,300	79.6	113	109	97
Stoneville 2B	1513	474	31.3	35.2	61.8	74,600	75.1	152	143	126
Wilds 17	990	276	27.9	40.0	66.2	81,900	76.8	114	103	79
Dif. barely significant	122	39	.6	.4	2.0	1,900	1.7	12	12	10
Dif. highly significant	162	51	.8	.5	2.6	2,400	2.2	16	15	13

hill. The plants grew very tall, and the foliage was very heavy. Boll-weevil infestations were bad. The entire production was picked on October 16. Earliness data were not obtained. Results of the 1945 Kelso test are given in table 7.

Delfos 531C, Stoneville 2B, Delfos 444, Cooker 100-9, Delfos 651, Coker 100-Staple Strain 1, and Delfos 9169 were leading money-value-per-acre producers when comparisons were made on the basis of Middling and Strict Low Middling grades. When comparisons were made on the basis of Low Middling grade, Stoneville 2B, Delfos 531C, Delfos 444, Coker 100-9, Delfos 651, Delfos 9169, and Bobshaw 1 were leading money-value-per-acre producers.

Results From 2- and 3-Year Variety Studies

Seasonal conditions have a marked effect upon the yield and other characteristics of cotton varieties. For this reason, data from a variety study conducted for only one season are probably not indicative of long-time performance. The results obtained by averaging the data obtained by conducting variety tests over a period of years provide much more useful information.

Variety tests similar to those described above were conducted during the 3 years 1943 to 1945 at Stoneville, Money, Heathman, Valley Hill, and Yazoo City, and during the years 1944 and 1945 at Kelso. Only 10 varieties were common to tests grown during all of the seasons.

Methods of conducting the tests, collecting samples, and analyzing data are the same as outlined for the 1945 tests. Dates of planting and picking at the different locations in 1943 and 1944 are given in bulletins 398 and 416 of the Mississippi Agricultural Experiment Station. The dates for the 1945 tests were given earlier in this report.

The 1943 and 1944 growing seasons in the Yazoo-Mississippi Delta were characterized by marked deficiencies of soil moisture during the boll-maturation period. The staple lengths of all varieties were shorter than normal, and the lengths of Bobdel, Coker 100, and the Delfos strains were affected more by dry

Table 8. **Yield and other data from cotton variety tests—Stoneville—3 year averages, 1943-45.**

Variety	Yield per acre								Total money value		
	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uniformity	Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	2335	754	32.3	35.4	73.2	56.4	87,100	79.7	194	180	152
Bobshaw 1	2371	830	35.0	34.4	71.7	49.6	87,000	80.2	203	190	163
Coker 100*	2346	852	36.3	35.3	72.1	46.7	83,400	76.4	218	201	171
Delfos 444	2387	702	29.4	36.5	84.5	51.0	78,500	78.1	199	178	144
Delfos 531C	2306	749	32.5	36.2	79.8	52.6	80,200	74.8	207	186	154
Delfos 651	2321	771	33.2	36.0	78.2	51.7	80,700	75.6	209	189	158
Deltapine 14	2333	931	39.9	34.6	77.2	42.9	79,400	80.3	229	214	184
Miller	2451	885	36.1	31.9	63.2	50.1	80,900	82.5	206	196	170
Stoneville 2B	2614	920	35.2	35.2	64.8	45.8	83,600	77.6	233	216	185
Wilds 15**	1978	625	31.6	40.2	74.2	38.1	92,500	76.1	213	187	132

*Coker 100-7 in 1943; Coker 100-8 in 1944; Coker 100-9 in 1945.
**Wilds 15 in 1943; Wilds 16 in 1944; Wilds 17 in 1945.

weather than were the lengths of the slower maturing varieties. Excessive amounts of rainfall during the planting, growing, and harvesting seasons occurred at all locations in 1945.

The yields of seed cotton and lint, gin turn-out, staple length, boll size, earliness, fiber tensile strength, uniformity of fiber length, and total money values, based upon Middling, Strict Low Middling, and Low Middling, are given in tables 8 to 13 for the respective locations.

The yields of seed cotton were determined by averaging the seed cotton yields obtained during each of the seasons that the tests were conducted at a given location.

The yield of lint was obtained by multiplying the average gin turn-out by the average yield of seed cotton per acre.

The gin turn-out data presented in each table were obtained by determining the mean lint percentages of 30 samples for each variety for the 3-year tests and of 20 samples for the 2-year tests.

The staple length, the number of bolls required for a pound of seed cotton, the percent of seed cotton picked during the first picking, the fiber tensile strength, and the fiber length uniformity ratio, were determined by averaging the values obtained for each variety during the seasons that the tests were conducted at a given location.

The total money values per acre were obtained by using the average yields of seed cotton and lint, the average staple length for the 2- or 3-year period, the average seed grade for 1944 and 1945, and the price of lint for the respective grades and lengths for 1945.

During the 3-year period 1943 to 1945, the leading money value producing varieties at Stoneville were Stoneville 2B, Deltapine 14, and Coker 100.

At Money the leading money-value producers were Stoneville 2B, Deltapine 14, and Bobshaw 1.

The leading money-value producers at Heathman, based on the 3-year averages, were Stoneville 2B and Deltapine 14.

Stoneville 2B, Miller, Bobshaw 1, and Deltapine 14 were leading money-value producers at Valley Hill during the 3-year period.

The total money values produced by Deltapine 14, Stoneville 2B, and Bobshaw 1 were higher than the values produced by the other seven varieties at Yazoo City during the years 1943 to 1945.

At Kelso the leading money-value producing varieties during the 2-year period 1944 to 1945 were Delfos 531C, Coker 100, and Stoneville 2B.

Table 9. Yield and other data from cotton variety tests—Money—3-year averages, 1943-45.

	Yield per acre								Total money value		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1870	587	31.4	35.4	73.2	65.2	84,100	77.6	151	140	118
Bobshaw 1	2059	698	33.9	34.6	70.4	60.2	82,300	77.7	171	161	138
Coker 100*	1748	621	35.5	35.3	72.2	59.2	79,100	75.2	159	146	125
Delfos 444	1988	567	28.5	36.5	81.3	61.8	74,500	75.0	161	144	117
Delfos 531C	1850	596	32.2	35.8	77.9	65.2	78,700	73.8	159	144	121
Delfos 651	1859	602	32.4	36.0	75.7	63.5	79,000	73.4	164	147	123
Deltapine 14	1830	723	39.5	34.5	77.0	52.4	76,800	77.8	177	166	142
Miller	1885	671	35.6	32.3	62.5	62.0	78,000	79.9	157	149	129
Stoneville 2B	2112	720	34.1	35.1	64.8	60.4	81,300	75.8	181	168	144
Wilds 15**	1407	428	30.4	40.1	72.5	53.1	89,400	76.9	145	128	91

*Coker 100-7 in 1943; Coker 100-8 in 1944; Coker 100-9 in 1945.
**Wilds 15 in 1943; Wilds 16 in 1944; Wilds 17 in 1945.

Table 10. Yield and other data from cotton variety tests—Heathman—3-year averages, 1943-45.

	Yield per acre								Total money value		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1547	501	32.4	35.1	79.7	72.7	84,200	76.2	126	117	100
Bobshaw 1	1735	599	34.5	34.1	77.1	68.9	84,500	78.2	145	136	117
Coker 100*	1596	575	36.0	34.7	81.0	68.3	80,700	74.3	142	133	114
Delfos 444	1763	518	29.4	35.9	87.8	75.3	76,500	75.4	140	126	106
Delfos 531C	1635	538	32.9	35.7	85.7	73.7	78,800	73.0	142	130	109
Delfos 651	1615	531	32.9	35.3	83.2	72.8	78,700	74.1	136	125	107
Deltapine 14	1555	627	40.3	33.9	83.4	61.8	76,200	77.6	151	142	122
Miller	1687	611	36.2	32.2	66.3	69.3	79,100	79.3	143	136	118
Stoneville 2B	1852	639	34.5	34.6	69.9	69.9	80,500	74.9	157	147	126
Wilds 15**	1378	438	31.8	39.5	79.1	56.0	87,800	72.8	145	129	92

*Coker 100-7 in 1943; Coker 100-8 in 1944; Coker 100-9 in 1945.
**Wilds 15 in 1943; Wilds 16 in 1944; Wilds 17 in 1945.

Table 11. Yield and other data from cotton variety tests—Valley Hill—3-year averages, 1943-45.

	Yield per acre								Total money value		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking ***	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1145	356	31.1	34.8	76.0	72.9	82,500	78.3	88	82	71
Bobshaw 1	1148	383	33.4	34.1	75.6	67.7	82,400	78.2	93	87	75
Coker 100*	879	312	35.5	34.7	75.5	72.9	77,600	73.7	77	72	62
Delfos 444	1023	293	28.6	35.8	85.1	71.9	71,700	76.4	78	71	60
Delfos 531C	874	279	31.9	35.5	83.6	67.5	76,500	73.3	73	67	56
Delfos 651	983	318	32.3	35.1	80.6	63.6	77,400	74.9	80	74	64
Deltapine 14	952	367	38.6	34.6	82.7	51.3	76,900	78.5	90	84	72
Miller	1154	413	35.8	31.9	66.8	62.1	77,100	80.5	96	91	79
Stoneville 2B	1172	400	34.1	34.4	69.1	61.2	79,200	75.7	98	92	79
Wilds 15**	792	238	30.0	39.2	78.3	60.4	87,400	74.3	78	69	50

*Coker 100-7 in 1943; Coker 100-8 in 1944; Coker 100-9 in 1945.
**Wilds 15 in 1943; Wilds 16 in 1944; Wilds 17 in 1945.
***Based on 1944 data only.

Table 12. Yield and other data from cotton variety tests—Yazoo City—3-year averages, 1943-45.

	Yield per acre								Total money value		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1880	603	32.1	35.0	76.9	77.4	82,500	77.8	150	140	120
Bobshaw 1	2138	748	35.0	34.2	74.9	74.0	81,000	79.2	181	171	146
Coker 100*	1852	678	36.6	35.0	77.8	73.9	78,300	75.4	168	157	135
Delfos 444	2001	590	29.5	35.8	86.8	76.4	74,000	77.0	158	143	120
Delfos 531C	1975	654	33.1	35.6	83.2	77.5	77,500	73.6	172	157	133
Delfos 651	2019	668	33.1	35.3	79.9	76.1	76,900	75.1	170	157	134
Deltapine 14	2070	832	40.2	34.0	81.8	70.3	75,600	79.3	200	189	162
Miller	2020	737	36.5	31.9	65.3	68.5	76,000	81.0	172	163	142
Stoneville 2B	2165	756	34.9	34.6	68.8	74.4	80,200	76.2	186	174	149
Wilds 15**	1677	522	31.1	39.9	75.2	64.6	88,000	74.1	175	156	110

*Coker 100-7 in 1943; Coker 100-8 in 1944; Coker 100-9 in 1945.

**Wilds 15 in 1943; Wilds 16 in 1944; Wilds 17 in 1945.

Table 13. Yield and other data from cotton variety tests—Kelso—2-year averages, 1944-45.

	Yield per acre								Total money value		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking ***	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1650	515	31.2	35.7	73.0	81.9	77,900	77.6	137	124	105
Bobshaw 1	1798	588	32.7	34.7	69.5	81.4	77,400	78.9	145	136	117
Coker 100*	1763	615	34.9	35.4	73.1	76.4	76,000	76.5	159	146	124
Delfos 444	1860	510	27.4	36.4	83.1	70.2	69,900	75.9	143	129	105
Delfos 531C	1885	590	31.3	36.2	76.7	82.5	73,600	73.6	163	147	121
Delfos 651	1805	565	31.3	35.8	75.4	78.9	73,600	75.1	151	137	115
Deltapine 14	1560	596	38.2	35.1	75.1	73.9	72,000	78.8	149	139	119
Miller	1626	569	35.0	32.9	63.2	78.5	72,100	80.5	134	127	110
Stoneville 2B	1879	624	33.2	35.2	63.9	73.8	76,600	76.5	158	148	125
Wilds 15**	1393	415	29.8	40.0	67.8	74.7	85,000	76.0	140	124	88

*Coker 100-8 in 1944; Coker 100-9 in 1945.

**Wilds 16 in 1944; Wilds 17 in 1945.

***Based on 1944 test only.

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Production of Hairy Vetch and its Utilization for Cotton Production

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PRODUCTION OF HAIRY VETCH AND ITS UTILIZATION FOR COTTON PRODUCTION

By J. L. ANTHONY

The use of winter legumes for soil improvement has greatly increased in Mississippi during comparatively recent years.

Of the several kinds of winter legumes adapted to Mississippi conditions, vetch is by far the most popular. Of the total acreage seeded in 1945, more than half was seeded to vetch.

Although sometimes utilized for hay, or seed, or grazing, winter legumes are mainly grown in Mississippi for soil improvement; and for this purpose are turned or plowed under in early spring and in time for planting the succeeding crop, usually cotton or corn.

No information is available as to the number of acres of cotton and corn, respectively, which follow vetch plowed under. Personal observation and esimates gathered at random from unofficial sources seem to indicate that approximately three-fourths of the vetch plowed under in Mississippi is followed by cotton, and approximately one-fourth by corn.

Problems in Vetch Production and Utilization

Many years ago when farmers in large numbers first began to plant winter legumes for soil improvement, the problems of production and utilization appeared to be quite simple of solution. From early writings it appeared that all one had to do to secure bumper yields was to sow winter legumes in the fall and turn them in the spring. Disappointments were quite common during the early days of vetch history, due perhaps most largely to lack of knowledge of plant food nutrients required for the optimum production of vetch, as well as the closely related plant food requirements for the optimum production of cotton following vetch.

The Mississippi Agricultural Experiment Station has done much work with vetch, especially during the past 12 years. Publications reporting this work have shown that in the hill sections of Mississippi, annual applications of phosphate are required for best vetch production. In common with other legumes, vetch has the capacity under favored growing conditions, to draw its requirements in nitrogen from the air. Cotton requires a complete fertilizer including nitrogen, phosphate, and potash; and cotton following vetch turned under utilizes the vetch plant residue, including nitrogen, so that most or all of the nitrogen is thus secured, leaving only potash and phosphate required for optimum cotton production.

Experiments have shown that an excellent crop of vetch plowed under supplies nitrogen available to the succeeding plant equivalent to about 32 pounds of actual nitrogen from commercial materials (200 pounds nitrate of soda, 100 pounds ammonium nitrate, or other equivalent material in nitrogen content). In addition to nitrogen (which vetch draws from the air and which the succeeding crop of cotton draws from the decomposed vetch material) both cotton and vetch require phosphate, potash, and probably lime.

That the relationship of vetch production and utlilization is a complex one is apparent when two important factors are kept in mind: (1) Used for soil improvement, vetch is valued exactly to the extent that yields of the following crops are increased; and (2) the needs and requirements for optimum production of both vetch and cotton must be considered, and that in relation to the soil and its cropping history.

Numerous farmers who produce vetch for soil improvement have been confronted with numerous problems incident to the two crops.

For example, since phosphate and potash are required by both vetch and cotton in the hill sections of Mississippi, many farmers are asking questions such as these:

May the needed amounts of phosphate and potash be applied either to vetch or cotton with equal results and with equal benefits in increased cotton yields?

Should the fertilizer application be made to the vetch or to the cotton, or should the required amounts be used in split applications, one-half applied to vetch and one-half to cotton?

Another question in which farmers are interested: Since relatively large yields of vetch are often produced, and since hay is produced in insufficient quantities on most Mississippi farms, would it be a profitable practice to use the vetch as hay and to apply required amounts of commercial nitrogen to the following crop of cotton?

In a vetch-cotton rotation, how necessary is potash, and what quantities should be used for maximum profit?

What is the place of lime in the vetch-cotton production program?

Fertilizer Experiments Conducted

To more nearly determine the effect of crop removal on the plant food supply of soils, to study the relationship existing between vetch production and cotton production, and to secure answers to many of the problems confronting farmers who utilize vetch for soil improvement, the Mississippi Experiment Station, in cooperation with the Tennessee Valley Authority, is conducting experiments at two locations in Mississippi.

On the farm of W. M. and R. C. Stinson, Lowndes County, Columbus, Mississippi, crop responses on Savannah fine sandy loam, a yellowish, sandy clay soil, have been studied.

The topography of the plot land is level to gently rolling, and the soil is fairly productive when properly fertilized.

In the main, this soil is usually low in its native supply of phosphorus and potash, and before maximum cotton production can be obtained, liberal amounts of these plant food nutrients must be supplied. This is especially true if winter legumes are used to furnish the nitrogen for the following crop of cotton.

At the Holly Springs Branch Station, Holly Springs, Mississippi, crop response on Grenada silt loam soil has been studied. The soil is largely silt and is fairly well drained. The topography is almost level and the soil is fairly productive even without fertilizer. Many crops, however, respond to fertilizers when applied and good yields are obtained in most cases.

Experiments on Savannah Fine Sandy Loam Soils

In the experiment conducted on the Stinson farm near Columbus, Mississippi, the following problems were studied:

1. The effect on the production of vetch of 500 pounds 0-8-4 fertilizer per acre, applied to vetch rather than to the succeeding cotton, whether the vetch is cut for hay or turned under.

2. The effect on the production of vetch of 500 pounds of 0-8-4 fertilizer per acre applied to cotton, rather than to the vetch, whether the vetch is cut for hay or turned under.

3. The effect of fertilized vetch (removed for hay) on the production of the following crop of unfertilized cotton.

4. The effect of fertilized vetch

Table 1. The effect of fertilized and unfertilized vetch, removed for hay and turned under, on the production of the following crops of fertilized and unfertilized cotton.

Soil type: Savannah fine sandy loam.

Years	500 lbs. 0-8-4 fertilizer per acre Lbs. of green vetch per acre when		No fertilizer applied to cotton Pounds of seed cotton per acre following vetch		No fertilizer applied to vetch Lbs. of green vetch per acre when		500 lbs. 0-8-4 fertilizer per acre Lbs. of seed cotton per acre following vetch	
	Cut for hay	Turned under	Cut for hay	Turned under	Cut for hay	Turned under	Cut for hay	Turned under
1940	1920	1920	276	272	1156	1064	354	332
1941	0000	0000	0000	0000	0000	0000	0000	0000
1942	7944	8348	1128	1290	3172	4880	1132	1328
1943	9600	10000	864	936	7680	9840	1048	1080
1944	5248	6016	944	1448	4128	4992	1306	1564
1945	3680	5024	1040	1771	3296	3120	1394	1856
1946	5312	7424	——	——	4992	5696	——	——
Average	4815	5533	709	953	3489	4227	872	1027
Average increase	——	718	——	244	——	738	——	155

(turned under) on the production of the following crop of unfertilized cotton.

5. The effect of fertilized cotton following unfertilized vetch (removed for hay) on the production of cotton.

6. The effect of fertilized cotton following unfertilized vetch (turned under) on the production of cotton.

7. The effect of 100 pounds of nitrate of soda per acre applied to cotton following fertilized vetch (removed for hay) on the production of cotton and vetch.

8. The effect of 500 pounds of 3-8-4 fertilizer per acre applied to cotton following unfertilized vetch (removed for hay) on the production of cotton and vetch.

9. The effect of 500 pounds of dolomitic limestone per acre applied to fertilized vetch (turned under) on the production of cotton and vetch.

10. The effect of 500 pounds 0-8-0 (basic slag) fertilizer per acre applied to vetch (turned under) on the production of vetch and the following crop of cotton.

11. The effect of 250 pounds 0-8-0 (basic slag) fertilizer per acre applied to vetch (turned under) and 250 pounds 0-8-0 (basic slag) fertilizer applied to unfertilized cotton, on the production of vetch and the following crop of cotton.

12. The effect of 500 pounds 6-8-4 fertilizer (no vetch) on the production of cotton.

13. The effect of no fertilizer and no vetch treatment on the production of cotton.

14. The effect of an additional 100 pounds of 50 percent muriate of potash per acre applied to cotton on the production of vetch and cotton, following the above treatments.

Fertilizer Applied to Vetch or Cotton

Since under the conditions of this test and according to numerous other experiments, both cotton and vetch require liberal amounts of phosphorus and perhaps of potash for optimum production, especially when the vetch is removed for hay, two questions naturally arise:

1. Should required amounts of fertilizer be applied to vetch or to cotton; and

2. What effect does removing a crop of vetch for hay have on the succeeding crop of cotton?

The results (table 1) indicate a slight

advantage in the direct application of the fertilizer to cotton rather than to vetch, and that cotton yields following vetch removed for hay were reduced considerably.

In the comparison in which vetch was removed for hay, where the fertilizer was applied to vetch and none to cotton, the succeeding crop of cotton yielded 709 pounds of seed cotton per acre; where the vetch was unfertilized and the succeeding crop of cotton was fertilized, the yield of seed cotton was 872 pounds.

In the comparison in which the vetch was turned under, cotton following the fertilized vetch crop yielded 953 pounds, whereas fertilized cotton following unfertilized vetch yielded 1072 pounds.

Vetch Cut for Hay or Turned

In this test the same comparisons are shown for vetch as for cotton, and similar results were obtained. The results (table 1) indicate slightly higher yields of vetch when the fertilizer was applied to vetch rather than to cotton, and that vetch yields following the removal of vetch for hay were less than yields of vetch after the preceding crops of vetch had been turned under.

In the comparison in which the vetch was removed for hay: where the vetch was fertilized and cotton unfertilized, the succeeding crop of vetch yielded 4,815 pounds of green vetch per acre; where the vetch was unfertilized and the succeeding crop of cotton was fertilized, the yield of green vetch was 3,489 pounds.

In the comparison in which the fertilized vetch was turned and followed by unfertilized cotton, the vetch yield was 5,533 pounds; whereas unfertilized vetch following fertilized cotton yielded 4,227 pounds.

It is clear from the foregoing that vetch produced for the purpose of increasing cotton production is more efficiently utilized when the entire crop is turned under than when the hay is removed and only the roots and stubble are turned under.

It will be noted that cotton following vetch removed for hay produced 244 pounds less seed cotton per acre than cotton following turned vetch. It appears that the removal of vetch for hay had less effect on the production of vetch than on cotton, since an increase of less than 1000 pounds were obtained following turned vetch.

The discussion above relates only the average yield and increase yields, since annual yields do not show definite trends due largely to weather conditions. For instance, during the year of 1941, the vetch and cotton crops on the Stinson farm resulted in a complete failure, weather conditions being such that vetch yields were negligible. The following crop of cotton was planted in early May, but there was not enough moisture to germinate the seed, and stands were not secured until after July 1. Cotton made good growth and put on a good crop of fruit, but was entirely destroyed by the boll weevil.

Commercial Nitrogen Applied to Cotton Following Fertilized and Unfertilized Vetch Removed for Hay

Vetch grown for the purpose of increasing cotton production is more efficiently utilized when the entire crop is turned than when the hay is removed and only the roots and stubble are turned. However, economic factors may enter into the picture on many farms, and the value of vetch-hay must not be overlooked. It will be noted (table 1) that cotton following fertilized vetch removed for hay produced approximately 250 pounds of seed cotton per acre less than when the vetch was turned, and fertilized cotton following unfertilized vetch removed for hay produced approximately 150 pounds seed cotton per acre less

Table 2. The effect of 100 pounds of nitrate of soda per acre applied to cotton following fertilized vetch removed for hay and turned under, and fertilized cotton following unfertilized vetch removed for hay and turned under, on the production of cotton.

Soil type: Savannah fine sandy loam.

Years	500 lbs. 0-8-4 fertilizer per acre applied to vetch when		100 lbs. soda to cotton following fertilized vetch	No nitrogen to cotton following fertilized vetch	Unfertilized vetch following fertilized cotton		500 lbs. 3-8-4 to cotton following unfertilized vetch	500 lbs. 0-8-4 to cotton following unfertilized vetch
	Yields of green vetch		Yields of seed cotton		Yields of green vetch		Yields of seed cotton	
	Cut for hay	Turned under	Cut for hay	Turned under	Cut for hay	Cut for hay	Cut for hay	Cut for hay
1940	1992	1920	328	276	980	1156	452	354
1941	0000	0000	0000	0000	0000	0000	0000	0000
1942	6588	7944	1120	1128	4820	3172	1272	1132
1943	9120	9600	856	864	6800	7680	1052	1048
1944	5824	5248	972	944	5056	4128	1376	1306
1945	3776	3680	1328	1040	3184	3296	1664	1394
1946	5792	5312	——	——	4800	4992	——	——
Average	4727	4815	767	709	3663	3489	969	872
Average increase	——	88	58	——	174	——	97	——

than when the vetch was turned. The question then arises: Can the vetch tops be removed as hay without loss in yield if the required amount of commercial nitrogen is applied to the cotton crop?

The use of 100 pounds of nitrate of soda per acre applied to cotton following fertilized and unfertilized vetch removed for hay increased cotton yields 58 pounds and 97 pounds of seed cotton per acre, respectively, over yields where the vetch was turned and no additional nitrogen was supplied.

Vetch yields were not affected by the commercial nitrogen applied to cotton. When the vetch was fertilized with 500 pounds of 0-8-4 fertilizer per acre, the yield of green vetch was approximately 5000 pounds, which is in the neighborhood of one ton of hay. Removal of approximately a ton of hay necessitates the application of 100 pounds of soda (or equivalent) per acre to maintain and slightly increase cotton yields.

Whether it is preferable to turn under the vetch crop, or to harvest it for hay and add nitrogen fertilizer, is a matter for the individual farmer to determine.

The Application of Lime in Addition to Phosphorus and Potash

In one of the comparisons made in the test, 500 pounds of lime was applied in addition to the 500 pounds 0-8-4 fertilizer applied under vetch. This treatment yielded 5,660 pounds of green vetch per acre, and was slightly more than when the same fertilizer was applied without lime.

The cotton which followed the fertilized and lime-treated vetch received no additional fertilizer and yielded 1,042 pounds of seed cotton. This is the highest yield of cotton in the vetch series, and was 89 pounds superior to the no-lime treatment. The data are shown in table 3.

The Value of Basic Slag for Vetch and Cotton

The application of 500 pounds per acre of 0-8-0 (basic slag) under vetch resulted in the production of 4,203 pounds of green vetch. The following crop of cotton, unfertilized, yielded 648 pounds of seed cotton.

Table 3. The effect of a 500 pound annual application of dolomitic limestone per acre applied to fertilized vetch (vetch turned under) on the production of cotton and vetch.
Soil type: Savannah fine sandy loam.

Years	500 pounds 0-8-4 per acre		Unfertilized cotton following vetch fertilized with 500 pounds 0-8-4 and 500 lbs. lime per acre	Unfertilized cotton following vetch fertilized with 500 pounds 0-8-4 per acre. No lime
	Yields in pounds of green vetch per acre		Yields in pounds of seed cotton per acre	
	500 lbs. lime	No lime		
	Vetch turned under	Vetch turned under	Vetch turned under	Vetch turned under
1940	2228	1920	316	272
1941	0000	0000	0000	0000
1942	8996	8348	1424	1290
1943	10080	10000	1192	936
1944	6624	6016	1440	1448
1945	4048	5024	1880	1771
1946	7648	7424	——	——
Average	5660	5533	1042	953
Average increase	127	——	89	——

The split application of basic slag (applied at the rate of 250 pounds 0-8-0 under vetch and 250 pounds under cotton) produced approximately the same amounts of vetch and cotton as did the single application of 500 pounds applied to vetch.

Yields under these basic slag treatments were the lowest in the test with the exception of the crop receiving no vetch and no fertilizer, and compare with 1,042 pounds of seed cotton per acre produced on the plots on which fertilizer and lime were applied to the vetch and no fertilizer was applied to the following crop of cotton.

Basic slag contains approximately 10 percent of P_2O_5 and approximately 50 percent lime. It contains no potash. That potash may be essential to optimum production on this soil is indicated by a test made in 1945 in which additional quantities of potash were used and which is discussed in a following section.

Complete Fertilizer Applied to Cotton

The highest 6-year average yield of seed cotton in the test was made when 500 pounds of 6-8-4 complete fertilizer per acre was applied to cotton and no vetch was employed (table 5). This treatment yielded 1,087 pounds seed cotton per acre, compared with 1,027 pounds when 500 pounds of 0-8-4 fertilizer was applied to cotton following unfertilized vetch, to 1,042 pounds following vetch fertilized with 500 pounds 0-8-4 and 500 pounds of dolomitic limestone, and to 455 pounds when no vetch and no fertilizer were used.

Since the same amounts of phosphate and potash were used on the vetch and no-vetch plots, there is a direct comparison of vetch nitrogen and commercial nitrogen. The results agree with numerous other results of tests in the hill section, in indicating that a good crop of vetch is equal in cotton yield to 24 to 32 pounds of nitrogen (obtained from ~~75~~ 15 to 200 pounds of nitrate of soda or ~~37~~ 7 to ~~50~~ 100 pounds of ammonium nitrate).

It is evident that for best cotton production on this soil, adequate fertilization is necessary, for yields were approximately doubled by both treatments. It is evident, too, that it makes little or no difference whether the nitrogen is secured from commercial sources or from vetch grown and turned under to supply the nitrogen.

Additional Potash Applied During 1945

To determine whether additional potash may profitably be used for cotton

Table 4: The effect of split applications of basic slag on the production of cotton and vetch. Soil type: Savannah fine sandy loam.

Years	500 pounds 0-8-0 basic slag per acre	250 pounds 0-8-0 basic slag per acre	Unfertilized cotton following vetch fertilized with 500 pounds 0-8-0 basic slag per acre	250 lbs. 0-8-0 basic slag applied to cotton following vetch fertilized with 250 pounds 0-8-0 basic slag per acre
	Yields in pounds of green vetch per acre		Yields in pounds of seed cotton per acre	
	Turned under	Turned under		
1940	2036	1976	272	312
1941	0000	0000	0000	0000
1942	6648	6792	1000	1064
1943	7920	7500	916	892
1944	5024	5056	772	712
1945	3568	3152	928	928
1946	4224	4960	——	——
Average	4203	4205	648	651
Average increase	——	2	——	3

production, 100 pounds of 50 percent muriate of potash per acre in addition to the specified annual applications was applied to cotton on one-half of all plots in the spring of 1945. The results are shown in table 6.

With minor exceptions, the several comparisons clearly indicate that on this soil an abundant supply of potash is required for optimum cotton production. In two of the comparisons the addition of 100 pounds of potash resulted in a loss in cotton production. It appears that when the 0-8-4 fertilizer was applied directly to cotton following unfertilized turned vetch, there was sufficient potash for optimum production, and that when cotton was fertilized with a complete fertilizer (500 pounds 6-8-4, no vetch) there was also no need for additional potash. These results are for 1945 only. hence are to be accepted only as a lead.

The outstanding response to additional potash was shown by the two basic slag treatments. These plots, of coure, received no potash, whereas all other fertilized plots in the test received 40 pounds of muriate of potash per acre annually for the 6-year period.

Without potash, the basic slag plots produced 648 and 657 pounds of seed cotton per acre, respectively, during the 6-year period, and each produced 928 pounds during the single year 1945. These yields were the lowest in the test, except the untreated plot which received neither fertilizer nor vetch.

With the application of 100 pounds of potash during 1945, the plot on which 500 pounds of 0-8-0 (basic slag) per acre was applied under vetch gave a yield of 1,979 pounds, an increase of 1,051 pounds seed cotton per acre. The crop on which 250 pounds 0-8-0 (basic slag) was applied to the vetch plus 250 pounds applied to the cotton, was increased to 2,056, an increase due to potash of 1,127 pounds per acre.

It is worthy of note that without potash the two basic slag plots were lowest in yield among the treated plots, but that with the additional potash the basic slag plots were second and third highest in the 1945 test.

Unfertilized cotton following turned vetch fertilized with 500 pounds of 0-8-4 and 500 pounds of lime per acre, produced the highest yields of seed cotton in the vetch series for the 6-year period. The 6-year average was 1,042 pounds seed cotton. The production for the one year 1945 was 1,880 pounds without additional potash, and 2,232 pounds with additional potash, an increase of 352

Table 5. A comparison of vetch nitrogen with commercial nitrogen on the yield of seed cotton, in relation to yields of cotton receiving neither vetch nor fertilizer.
Soil type: Savannah fine sandy loam.

Years	Unfertilized vetch following cotton fertilized with 500 lbs. 0-8-4 per acre	500 lbs. 0-8-4 per acre applied to cotton following unfertilized vetch	500 pounds 6-8-4 fertilizer per acre	No fertilizer
	Yields in pounds of green vetch per acre		Yields in pounds of seed cotton per acre	
	Turned under	Turned under	No vetch	No vetch
1940	1064	332	524	276
1941	0000	0000	0000	0000
1942	4880	1328	1300	584
1943	4992	1080	1084	536
1944	3120	1564	1728	700
1945	5696	1856	1888	632
1946	4227	——	——	——
Average	——	1027	1087	455
Average increase	——	——	60	——

pounds of seed cotton per acre due to additional potash.

Plots that received the same fertilizer treatment as above but having no lime, produced a 6-year average yield of 953 pounds of seed cotton per acre. The 1945 yield without additional potash was 1,771 pounds, whereas the plots receiving additional potash yielded 1,931 pounds, an increase of 160 pounds due to additional potash.

The yields of cotton following vetch removed for hay were less than those following turned vetch in every case. However, when the fertilizer was applied directly to the cotton, the cotton yields were reduced less than when the fertilizer was applied to the vetch and followed by unfertilized cotton.

Additional potash applied to the 1945 cotton crop, following fertilized vetch removed for hay, produced 1,416 pounds seed cotton per acre as compared to 1,040 pounds without additional potash, an increase of 376 pounds due to additional potash. Additional potash applied to the cotton crop in 1945 following fertilized turned vetch produced 1,931 pounds of seed cotton per acre, whereas without additional potash the yield was 1,771 pounds, an increase of 160 pounds.

Fertilized cotton following unfertilized vetch removed for hay produced 1,394 pounds of seed cotton for the one year 1945; but when 100 pounds of additional potash was applied to fertilized cotton following unfertilized vetch removed for hay, the cotton yield was 1,552 pounds, an increase of 158 pounds.

It is interesting to note that cotton yields were slightly depressed when additional potash was applied to cotton fertilized annually with 500 pounds 0-8-4 and following unfertilized turned vetch. Plots receiving the additional potash yielded 1,752 pounds seed cotton per acre, whereas the plot that had not been fertilized with additional potash yielded 1,856 pounds, a loss of 104 pounds seed cotton per acre.

The cotton plot that had been fertilized annually with 500 pounds 6-8-4 per acre (no vetch) yielded 1,888 pounds seed cotton in 1945 without additional potash and 1,819 pounds with additional potash, which also resulted in a loss of 69 pounds seed cotton. It is entirely possible that the decline in cotton yields in both cases was due to soil variations rather than to the potash treatment. However, it is evident when applied directly to cotton that the 20 pounds of actual potash carried in 500 pounds of 0-8-4 and 6-8-4 is enough to supply the

Table 6. **The effect of crop removal, and continuous cropping of cotton and vetch on the potash supply of Savannah fine sandy loam soil.**
Soil type: Savannah fine sandy loam.

A. Fertilizer applied to vetch, none to cotton.

Vetch fertilized with 500 pounds per acre of	Disposition of vetch	7 years average vetch yields 1940-1946	1946 vetch yields following	
			No additional potash	Potash applied to cotton in 1945
		Yields in pounds of green vetch per acre.		
0-8-4 superphosphate	Cut for hay	4815	5312	6528
0-8-4 superphosphate	Turned under	5533	7424	7264
No fertilizer	Cut for hay	3489	4992	5568
No fertilizer	Turned under	4227	5696	5536
0-8-4 superphosphate	Cut for hay	4727	5792	6560
No fertilizer	Cut for hay	3663	4800	5728
No fertilizer	No vetch	——	——	——
No fertilizer	No vetch	——	——	——
0-8-4 superphosphate plus lime	Turned under	5660	7648	8288
500 lbs. 0-8-0 basic slag	Turned under	4203	4224	6752
250 lbs. 0-8-0 basic slag	Turned under	4205	4960	7744

B. Fertilizer applied to cotton, none to vetch.

Cotton fertilizer with 500 lbs. per acre of	6 year average cotton yields	1945 cotton yields following		
		No additional potash	100 lbs. of additional potash per acre	Increase over additional potash
	Yields in pounds of seed cotton per acre			
No fertilizer	709	1040	1416	376
No fertilizer	953	1771	1931	160
0-8-4	872	1394	1552	158
0-8-4	1027	1856	1752	—104
3-0-0	767	1328	1672	344
3-8-4	969	1664	1947	283
6-8-4	1087	1888	1819	—69
No fertilizer	455	632	675	13
No fertilizer	1042	1880	2232	352
No fertilizer	648	928	1979	1051
250 lbs. 0-8-0 basic slag	657	928	2055	1127

potash needed for good cotton production on this soil, even with turned-under vetch in the picture.

In one comparison cotton fertilized annually with 500 pounds of 3-8-4 per acre and following unfertilized vetch removed for hay, yielded 1,664 pounds of seed cotton per acre for the year 1945; cotton receiving the same fertilizer treatment plus 100 pounds of muriate of potash per acre yielded 1,947 pounds, an increase of 283 pounds of seed cotton per acre. The no-vetch, no-fertilizer plot yielded 632 pounds of seed cotton per acre, as compared to 675 pounds when the additional 100 pounds of muriate of potash was applied, an increase of only 13 pounds of seed cotton. This perhaps indicates that adequate quantities of all three plant food nutrients are required, nitrogen and phosphorus as well as potash.

Summary of Experiments Conducted on Savannah Fine Sandy Loam Soil

Cotton and vetch production studies were made on the farm of W. M. and R. C. Stinson near Columbus, Mississippi. The soil was Savannah fine sandy loam, a fairly productive soil when adequate quantities of plant food nutrients are supplied.

These studies during the 6-year and 7-year period seem to indicate the following:

1. In order to produce cotton at profitable levels on soils that are not naturally fertile, annual applications of phosphate nutrients are required whether in a soil improvement program making use of legumes, or whether by the application of sufficient amounts of complete fertilizers.

2. Vetch produced for soil improvement is best utilized when turned back to the soil; however, by using 100 pounds of nitrate of soda per acre applied to cotton following vetch removed for hay, the cotton yields are slightly better than yields obtained from cotton following turned vetch.

3. Annual applications of lime applied to vetch at the rate of 500 pounds per acre for the 7-year period, did not increase vetch yields; however, cotton yields were significantly increased when lime was applied to the vetch and followed by cotton.

4. Basic slag alone applied to vetch at the rate of 500 pounds 0-8-0 per acre yielded less green vetch and less seed cotton than any of the 0-8-4 fertilizer treatments where the vetch was turned under.

5. The 500 pounds of 6-8-4 fertilizer treatment (no vetch) produced a 6-year average yield of 1,087 pounds of seed cotton per acre, whereas the 0-8-4 fertilizer plus vetch nitrogen yielded 1,027 pounds, and the no-vetch and no-fertilizer plot yielded only 455 pounds. A slight advantage was shown for commercial nitrogen over vetch nitrogen.

6. Potash applied at the rate of 100 pounds per acre under cotton in 1945 and following vetch fertilized with basic slag at the rate of 500 pounds 0-8-0 per acre, and the split application of 250 pounds of 0-8-0 basic slag applied to cotton—increased yields of seed cotton 1,051 pounds and 1,127 pounds, respectively. Yields of vetch following the 1945 treatment of potash applied to cotton were increased 2,528 pounds and 2,784 pounds of green vetch per acre, respectively.

Additional potash increased cotton yields 160 pounds and 376 pounds of seed cotton per acre, respectively, following turned and removed vetch fertilized with 500 pounds 0-8-4 fertilizer per acre, and 352 pounds following turned vetch fertilized with 500 pounds of 0-8-4 fertilizer plus 500 pounds of lime per acre.

Additional potash applied to unfertilized cotton following fertilized vetch was by far more valuable than when applied to fertilized cotton following unfertilized vetch.

Experiments on Grenada Silt Loam Soil

In the experiment conducted on the Holly Springs Branch Station, at Holly Springs, Mississippi, the same problems were studied as on the Stinson farm near Columbus, with one exception. Field observations and results obtained at this location indicated that this soil is fairly well supplied with potash, therefore the use of additional potash was not tested.

Vetch Removed for Hay or Turned Under

In two of the treatments, direct comparisons may be had of the vetch yields when removed for hay and when turned under, and the yields of the following crops of cotton when the vetch was removed for hay or turned. In both cases it is clear that for optimum cotton production vetch should be turned rather than removed for hay. In point of the weight of green vetch produced per acre, it appears to make little or no difference whether the vetch is removed for hay or turned under, since vetch yields were

Table 7. The effect of fertilized and unfertilized vetch removed for hay and turned under, on the production of the following crops of fertilized and unfertilized cotton.
Soil type: Grenada silt loam.

Years	Vetch fertilized with 500 lbs. 0-8-4 per acre		No fertilizer applied to cotton		No fertilizer applied to vetch		Cotton fertilized with 500 lbs. 0-8-4 per acre	
	Pounds of green vetch per acre		Pounds of seed cotton per acre following vetch		Pounds of green vetch per acre		Pounds of seed cotton per acre following vetch	
	Cut for hay	Turned under	Cut for hay	Turned under	Cut for hay	Turned under	Cut for hay	Turned under
1940	3221	3205	768	728	1381	1328	808	896
1941	7280	6666	962	940	4459	4953	864	1046
1942	3380	3956	1060	1436	2568	3064	1012	1356
1943	8880	9120	672	740	6640	7520	636	768
1944	6336	6448	1180	1364	5408	6080	1212	1436
1945	2144	2424	1080	1200	1096	1504	960	1148
1946	1728	1856	——	——	704	1152	——	——
Average	4710	4811	953	1068	3178	3657	915	1108
Average increase	——	101	——	115	——	479	——	193

practically the same under both conditions.

When 500 pounds of 0-8-4 fertilizer was applied under vetch and no fertilizer was applied to the following crop of cotton, the 7-year average green-weight yield of vetch from the plot cut for hay was 4,710 pounds, while the yield of the vetch turned was 4,811 pounds. The yield of cotton following vetch removed for hay was 953 pounds of seed cotton, whereas the yield of cotton following the crop of vetch turned under was 1,068 pounds. The yields of unfertilized cotton following fertilized vetch removed for hay resulted in a loss of 115 pounds of seed cotton per acre. Results are shown in table 7.

It is clear from the foregoing that on this soil, vetch produced for the purpose of increasing cotton production is more efficiently utilized when the entire crop is turned under than when the hay is removed and only the roots and stubble are turned under. However, the value of vetch used for hay can not be overlooked, and in some instances it may be of equal or greater value as feed. A fuller discussion of economic factors involved is included in the discussion of the similar test on sandy loam soil.

Fertilizer Applied to Vetch or to Cotton

Since under the conditions of this test, the fertilization of both cotton and vetch is to be considered, the question naturally arises: Should required amounts of fertilizers be applied to vetch or to cotton? The results indicate a slight advantage in the application of the fertilizer directly to the vetch for best vetch production, whether turned or removed for hay; but whether the fertilizers were applied to vetch or to cotton had but little effect on the production of cotton following vetch removed for hay or turned.

In the comparison in which vetch was removed for hay, where the vetch was fertilized and the cotton unfertilized, the succeeding crop of cotton yielded 953 pounds of seed cotton per acre. Where the vetch was unfertilized and the succeeding crop of cotton was fertilized, the yield of cotton was 915 pounds, an increase of 38 pounds. It is doubtful that the slight increase is significant.

In the comparison in which the vetch was turned, cotton following the ferti-

Table 8. The effect of 100 pounds of nitrate of soda per acre applied to cotton following fertilized vetch removed for hay and turned under, and fertilized cotton following unfertilized vetch removed for hay and turned under on the production of cotton.

Soil type: Grenada silt loam

Years	500 lbs. 0-8-4 fertilizer per acre applied to vetch, when		100 lbs. of nitrate of soda per acre applied to cotton following fertilized vetch when,	No commercial nitrogen applied to cotton following fertilized vetch when,	Unfertilized vetch		500 lbs. of 3-8-4 fertilizer per acre applied to cotton following unfertilized vetch when,	500 lbs. of 0-8-4 fertilizer per acre applied to cotton following unfertilized vetch when,
	Yield of green vetch per acre		Yield of seed cotton per acre		Yield of green vetch per acre		Yield of seed cotton per acre	
	Cut for hay	Turned under	Cut for hay	Turned under	Cut for hay	Cut for hay	Cut for hay	Cut for hay
1940	3504	3205	920	728	1045	1381	1080	808
1941	6869	6666	982	940	4192	4459	982	864
1942	4496	3956	1284	1436	2828	2568	1456	1012
1943	9440	9120	684	740	6960	6640	660	636
1944	5360	6448	1484	1364	3808	5408	1312	1212
1945	2264	2424	1120	1200	1416	1096	1296	960
1946	1792	1856	——	——	1344	704	——	——
Average	4818	4811	1079	1068	3085	3178	1131	915
Average increase	7	——	11	——	——	93	216	——

lized vetch crop yielded 1,068 pounds of seed cotton per acre; whereas fertilized cotton following unfertilized vetch yielded 1,108 pounds. This slight advantage in favor of direct application of the fertilizer to the cotton following turned vetch is similarly of doubtful significance. Data shown in table 7.

Commercial Nitrogen Applied to Cotton Following Vetch Removed for Hay

When vetch is grown for the purpose of increasing cotton production, it is more efficiently utilized when the entire crop is turned than when the hay is removed and only the roots and stubble are turned under. However, economic factors may enter into the picture on many farms. The value of vetch hay can not be overlooked, and the farmer is justified in asking, Can I afford to use the vetch tops as hay and keep cotton yields at high levels by applying required amounts of commercial nitrogen to the cotton crop?

The results (table 8) show little or no difference in cotton production following fertilized vetch removed for hay or turned under, when the cotton following removed vetch received commercial nitrogen. However, commercial nitrogen applied to cotton following unfertilized vetch removed for hay showed a substantial increase.

One hundred pounds of nitrate of soda per acre applied to cotton following fertilized vetch removed for hay, produced a 6-year average yield of 1,079 pounds of seed cotton per acre, whereas cotton following fertilized turned vetch (no commercial nitrogen) yielded 1,068 pounds. In these comparisons the same amount of vetch was removed for hay as that turned under, being approximately 4,800 pounds of green vetch per acre in each case.

Cotton fertilized with 500 pounds of 3-8-4 fertilizer per acre following the removal of approximately 3,000 pounds unfertilized green vetch for hay, yielded

Table 9. The effect of a 500 pound annual application of dolomitic limestone per acre applied to fertilized vetch (vetch turned under) on the production of cotton and vetch.
Soil type: Grenada silt loam.

Years	Vetch fertilized with 500 lbs. 0-8-4 fertilizer per acre		Unfertilized cotton following vetch fertilized with 500 pounds of 0-8-4 and 500 pounds lime per acre	Unfertilized cotton following vetch fertilized with 500 pounds 0-8-4 fertilizer per acre and no lime
	500 pounds of lime per acre	No lime		
	Yields in lbs. of green vetch per acre		Yields in pounds of seed cotton per acre	
	Vetch turned under	Vetch turned under	Vetch turned under	Vetch turned under
1940	5077	3205	1056	728
1941	11461	6666	1106	940
1942	5476	3956	1548	1436
1943	11280	9120	696	740
1944	8144	6448	1360	1364
1945	3368	2424	1580	1200
1946	3136	1856	——	——
Average	6849	4811	1221	1068
Average increase	2038	——	153	——

1,131 pounds of seed cotton per acre. Cotton fertilized with 500 pounds 0-8-4 per acre (no additional nitrogen) following the removal of approximately the same amount of green vetch, yielded 915 pounds. This is an increase of 216 pounds attributable to the application of nitrogen after the vetch tops had been removed for hay.

The Application of Lime in Addition to Phosphorus and Potash

In one of the comparisons made in the test, 500 pounds of lime was applied in addition to the application of 500 pounds 0-8-4 fertilizer under vetch. The 7-year average vetch yield following this treatment was 6,849 pounds of green vetch per acre, the highest yield of green vetch in the test. Unfertilized cotton following this 6,849 pounds of turned vetch, yield 1,221 pounds of seed cotton per acre, which was the highest cotton yield in the vetch series, except one treatment that produced 10 pounds more seed cotton per acre.

Vetch fertilized with 500 pounds of 0-8-4 fertilizer and no lime produced 4,811 pounds of green vetch per acre, and unfertilized cotton following this amount of turned vetch, yielded 1,068 pounds, an increase of 153 pounds of seed cotton per acre attributable to the 500-pound lime treatment. These results are shown in table 9.

The Value of Basic Slag

The application of 500 pounds per acre of basic slag under vetch resulted in the production of 5,842 pounds of green vetch. The following crops of unfertilized cotton yielded 1,172 pounds of seed cotton.

The split application of basic slag, in which 250 pounds of 0-8-0 (basic slag) was applied under vetch and 250 additional pounds applied under the succeeding crop of cotton, showed no appreciable benefits to vetch or cotton. The 7-year average yield of vetch was 5,779 pounds of green vetch when half the basic slag was applied to vetch and half to cotton, as compared to 5,842 pounds for the application of 500 pounds of 0-8-0 (basic slag) applied to vetch. Cotton fertilized with 250 pounds of 0-8-0 (basic slag) per acre and following turned vetch that had received 250 pounds of 0-8-0 (basic slag) per acre, yielded 1,231 pounds of seed cotton per acre; this was the highest cotton yield in the vetch series.

Table 10. The effect of 500 pounds 0-8-0 basic slag fertilizer and a split application of 0-8-0 basic slag (250 pounds applied to cotton and 250 pounds applied to vetch, vetch turned under) on the production of cotton and vetch.

Soil type: Grenada silt loam.

Years	500 lbs. 0-8-0 basic slag per acre	250 lbs. 0-8-0 basic slag per acre	Unfertilized cotton following vetch fertilized with 500 lbs. 0-8-0 basic slag per acre	250 lbs. 0-8-0 basic slag applied to cotton following vetch fertilized with 250 lbs. 0-8-0 basic slag per acre
	Yield in lbs. of green vetch per acre		Yield in lbs. of seed cotton per acre	
	Vetch turned under	Vetch turned under	Vetch turned under	Vetch turned under
1940	3984	3339	1144	1080
1941	8709	8592	1128	1160
1942	5300	4852	1424	1380
1943	10320	10320	708	740
1944	7424	7712	1272	1328
1945	2856	2888	1356	1596
1946	2304	2752	——	——
Average	5842	5779	1172	1231
Average increase	63	——	——	59

Basic slag contains approximately 10 percent of P_2O_5 and approximately 50 percent lime. It contains no potash. The results obtained from the use of basic slag are similar to those obtained from 0-8-4 fertilizer plus lime, in that the highest vetch and cotton yields were obtained following the phosphate-plus-lime treatments in the vetch series. Results are shown in table 10.

Other tests have shown that this soil is fairly well supplied with potash.

Complete Fertilizer Applied to Cotton

The highest 6-year average yield in the test was made when 500 pounds of 6-8-4 fertilizer per acre was applied to cotton and no vetch was employed.

This treatment yielded 1,321 pounds of seed cotton per acre, compared with 787 pounds seed cotton from the no-vetch, no-fertilizer plots; and to 1,108 pounds seed cotton when 500 pounds 0-8-4 was applied to cotton following unfertilized vetch. The results show an increase attributable to complete fertilizer of 534 pounds seed cotton per acre over the no-vetch, no-fertilizer plot, and of 213 pounds seed cotton per acre over the vetch nitrogen plot (table 11).

Relation of Cotton Yields to Vetch Yields

It has been generally accepted during recent years that a good crop of vetch is approximately 6,000 pounds of green material per acre, and that such a yield of vetch turned under would supply sufficieent nitrogen to enable approximately the maximum production in the following crop of cotton. A comparison of vetch yields with yields of following crops of cotton, shown in tables 1 and 7, gives scant information on the relationship between the amount of vetch turned under and the amount of cotton produced in the following crop.

On Savannah fine sandy loam soil, vetch fertilized with 500 pounds of 0-8-4 fertilizer produced a 7-year average yield of 5,533 pounds of green vetch per acre, and was followed by unfertilized cotton that yielded 953 pounds seed cotton; whereas, fertilized cotton following 4,227 pounds of unfertilized green vetch per acre produced 1,027 pounds of seed cotton. This difference is perhaps due to the fertilizer being applied directly to the cotton rather than to the vetch and indicates that a direct application of the fertilizer to the cotton is of more value to the cotton crop than its application to vetch.

Table 11. A comparison of vetch nitrogen with commercial nitrogen on the yield of seed cotton in relation to yields of cotton receiving neither vetch nor fertilizer.
Soil type: Grenada silt loam.

Years	Unfertilized vetch following cotton fertilized with 500 lbs. 0-8-4 per acre	500 lbs. 0-8-4 per acre applied to cotton following unfertilized vetch	500 lbs. 6-8-4 fertilizer per acre	No fertilizer
	Yields in lbs. of green vetch per acre		Yields in lbs. of seed cotton per acre	
	Vetch turned under	Vetch turned under	No vetch	No vetch
1940	1328	896	1280	872
1941	4953	1046	1254	812
1942	3064	1356	1696	792
1943	7520	768	784	560
1944	6080	1436	1360	964
1945	1504	1148	1556	724
1946	1152	——	——	——
Average	3657	1108	1321	787
Average increase	——	——	213	—534

On Grenada silt loam soil a 7-year average yield of 4,811 pounds of fertilized vetch was turned under, and unfertilized cotton following this vetch yielded 1,068 pounds of seed cotton per acre; whereas, fertilized cotton following 3,657 pounds of green vetch per acre yielded 1,108 pounds of seed cotton. Here again, the lowest yields of vetch was followed by the highest yields of cotton, which is also perhaps due to the direct application of the fertilizer to the cotton crop rather than to the vetch crop.

Summary of Experiments Conducted on Grenada Silt Loam Soils

Grenada silt loam soil was used for the cotton and vetch production studies made at the Holly Springs Branch Experiment Station, Holly Springs, Mississippi. Grenada silt loam is of Brown loam origin, and is a fairly productive soil even without fertilizer. However, most crops respond to applied fertilizers and in most cases good yields are obtained.

From the above mentioned studies during the 6-year and 7-year period, the results seems to indicate the following:

1. In order to produce cotton more profitably on this soil, annual applications of phosphorus and lime are required, whether supplied in a legume soil improvement program or whether by the addition of sufficient amounts of complete fertilizers.

2. Fertilized cotton following unfertilized vetch turned under, yielded slightly more seed cotton per acre than did unfertilized cotton following fertilized vetch turned under.

3. The removal of fertilized vetch for hay depressed cotton yields 115 pounds of seed cotton per acre, whereas the removal of unfertilized vetch for hay depressed cotton yields 193 pounds.

4. When a 7-year average yield of 4,818 pounds of fertilized vetch per acre was removed for hay and followed by cotton that had been fertilized with 100 pounds of nitrate of soda per acre, cotton yields were slightly better than those obtained following approximately the amount of vetch turned under, but without the aid of commercial nitrogen.

When 7-year average yields of 3,085 pounds and 3,178 pounds of unfertilized vetch, respectively, were removed for hay, and followed by cotton fertilized with 500 pounds of 3-8-4 fertilizer and 500 pounds of 0-8-4 fertilizer per acre, the cotton yields were 1,131 pounds and 915 pounds, respectively. This is an increase of 216 pounds seed cotton in favor of the added nitrogen.

5. The treatment using 500 pounds of 0-8-4 fertilizer plus 500 pounds of lime produced a 7-year average yield of 6,849 pounds of green vetch per acre, the highest yield in the test. Unfertilized cotton following this treatment and this amount of vetch turned under yielded 1,221 pounds of seed cotton per acre, as compared to 1,068 pounds for unfertilized cotton following turned vetch that had been fertilized with 500 pounds 0-8-4 fertilizer and no lime. An increase of 153 pounds of seed cotton per acre following the lime treatment.

6. The 500 pounds of 0-8-0 (basic slag) treatment applied to vetch produced a 7-year average yield of 5,842 pounds of green vetch per acre, the second highest yield in the experiment. Unfertilized cotton following this treatment and this amount of vetch turned under yielded 1,172 pounds of seed cotton per acre, as compared to 1,231 pounds that was produced following the split application of basic slag and with approximately the same amount of vetch turned under.

7. The treatment using 500 pounds of 6-8-4 fertilizer (no vetch) produced a 6-year average yield of 1,321 pounds of seed cotton per acre, whereas the 0-8-4 fertilizer plus vetch nitrogen yielded 1,108 pounds, and the no-vetch and no-fertilizer plat yielded 787 pounds. An increase of 213 pounds seed cotton for commercial nitrogen over vetch nitrogen and 534 pounds over no-vetch, no-fertilizer.

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THE RELATION OF SOIL FERTILITY To HUMAN NUTRITION

By

OLIVE SHEETS

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SUMMARY

Experimental evidence is lacking which would support the belief that plant and animal foods produced in deficient soil areas have a lower nutritive value than the same foods produced on fertile soil. Few animal experiments and no experiments on humans have been undertaken which give information on this subject.

The great majority of the experiments showing the effects of soil fertility on the nutritive value of foods have been made on plants.

Many factors affect the nutritive value of plants. These include the nature and composition of the soil, fertilizer treatments, variety of the plant, climate, and weather conditions. Studies have shown that of these factors, variety and climatic conditions may have a greater effect on the nutrients in the plant than soil fertility. Light has been found to have a marked influence on vitamin C formation.

A number of experiments have been cited which show that well grown plants from fertilized soil may under certain conditions have a lower content of several nutrients than poorly grown plants. Thus, turnip greens fertilized with nitrogen gave a higher yield but contained less calcium, phosphorus, iron, and vitamin C than plants produced from the same seed on unfertilized soil.

Hay grown on phosphorus deficient soil, was found by one group of investigators to be as digestible and to produce as good growth in animals as hay grown on the same soil fertilized with phosphorus.

The poor nutritive conditions found among people living in poor soil areas seem to be directly related to the unproductivity of the soil and the resulting poverty of the people. They do not produce enough food of the right kinds for an adequate diet, and because of low incomes, they do not purchase it.

The Relation of Soil Fertility to Human Nutrition

By OLIVE SHEETS

No one would question the fact that a most fundamental relationship exists between the fertility of the soil and the diet of people. The importance to human welfare of conserving and increasing the fertility of the soil can hardly be overemphasized.

It is commonly assumed, however, that the relationship between soil and human nutrition is a direct one. As one writer has expressed it, "If the soil does not have it in it, the plants and animals that grow there do not, or the people who eat these plants and animals." To many people this means that a person may eat all of the recommended foods in sufficient amounts, yet his diet will still be inadequate if the foods have been produced on deficient soil.

A statement expressing this view may be quoted from a popular leaflet. The author states that a "good diet," that is, one recommended by a recognized authority "is not enough." He goes on to say, "Theoretically, such a diet should meet all your bodily requirements. Actually, however, it cannot meet these requirements unless the food has been produced on **completely fertile** soil. Thus, a person could consume in excess of the recommended quantities of all the foods listed in such a "health diet" if they came from deficient soils and still fail by a wide margin of supplying all the minerals and vitamins which he requires for maintenance of health."

Such beliefs are based upon the following evidence: (1) It has been observed for many years that livestock produced in certain poor soil areas in the United States and other parts of the world suffer from nutritional diseases. Further study has shown that there were mineral deficiencies in the soil and in the forage. (2) Humans also suffer from nutritional diseases which seem to be the direct result of soil deficiencies.

If this evidence is carefully examined, we find that while nutritional diseases of animals, such as anemia, goiter, and bone diseases, may be traced to the lack of specific soil constituents, only goiter in humans can be so traced. This disease both in animals and man develops in areas where the plants and water lack iodine, indicating a soil deficiency in available iodine.

Statements assuming a direct relationship between plant, animal, and human nutrition are impressive. They have great popular appeal in pointing out the importance of good agricultural practices and soil improvement to the health and welfare of rural people.

To establish the truth of such statements, however, **scientific evidence is necessary.** This evidence can come only from many carefully controlled experiments. These experiments would have to prove that plants grown on poor soils have a lower nutritive value than the same varieties of plants grown on good soil. They would have to prove that animal foods produced in poor soil areas are deficient in nutrients as compared with those produced in good soil areas. It would be necessary for the animals from which the animal foods in the two areas were obtained to eat the same kinds of food in about the same amounts.

Finally, the experiments would have to prove that groups of people living in poor soil areas suffer from nutritional deficiencies not found among comparable groups living in good soil areas when **both** groups eat the same kinds and amounts of locally grown foods. In both the animal and human studies, careful analysis would have to be made of all foods eaten and the nutritional condition of the animals and human subjects determined.

Not many studies have been made of the kind described in the foregoing list of experiments. Of these, nearly all relate to the nutritive value of plants as influenced by soil fertility. Very few relate to animal studies and no studies of the kind described have been made on humans.

Some information, however, is available which indicates the relation of soil fertility to human nutrition. In this bulletin an attempt will be made to summarize studies giving such information, under the following headings:

1. Studies showing the effect of soil fertility, including fertilizer treatment, and other factors on the nutritive value of plants.
2. Animal feeding experiments.
3. Human dietary studies.

Studies Showing the Effect of Soil Fertility and Other Factors on the Nutritive Value of Plants

There are many factors which influence the nutritive composition of plants. Among them are soil, fertilizers, climate or weather conditions, and species or varieties. These factors are interrelated. Thus, the addition of one or more soil nutrients affects the absorption of others. Also, weather conditions, such as rainfall, temperature, and light, have an important effect upon the nutrients taken up by the plant and the way in which they are utilized. As a consequence, the same varieties grown on the same soil will vary in composition from season to season and from year to year.

Because of great variations in the nature and composition of soils and the influence which the other factors mentioned have upon soil and the uptake of its nutrients by plants, it is not surprising that the results of independent studies are often conflicting.

In this paper, studies in which the Mississippi Experiment Station participated will be described, and the results of other studies summarized. An attempt will be made to bring out some of the most important findings which relate to the effect of soil, fertilizer, and other factors on the mineral and vitamin content of plants.

Minerals

Cooperative Experiments on Turnip Greens

Cooperative studies were made by a group of workers in several southern experiment stations, in which the departments of Home Economics, Chemistry, and Horticulture of the Mississippi Experiment Station participated. Extensive field experiments were carried out on turnip greens and cowpeas.[1 2 3]

The effects of fertilizer, soil composition, and certain climatic conditions on the calcium, phosphorus, and iron content of turnip greens were studied. One variety of greens (Seven Top) from the same lot of seed, and with the same fertilizer treatments, was grown in 19 localities in six southern states during successive seasons.

A total of 30 crops were produced, each being one experiment. A factorial design was used for the experiments; that is, one which included all combinations of several different sets of treatments or "factors." There were 16 fertilizer treatments with two replications for each treatment, so that there were 32 plots for each experiment. Nitrogen (N), calcium (Ca), phosphorus (P), and potassium (K) were added singly and in all combinations. The low level for each of the four nutrients was a check plot consisting of the natural untreated soil. The 16 fertilizer treatments were as follows: NPKCa, NPK, NPCa, NP, NKCa, NK, NCa, N, PKCa, PK, PCa, P, KCa, K, Ca and check.

The quantities of fertilizer used were

Table 1. The average effects (percentage increase or decrease) on the calcium, phosphorus, and iron content of turnip greens resulting from the addition of the four fertilizer factors to the soil.

Fertilizer factors	Calcium: 29 experiments 464 plots	Phosphorus: 29 experiments 464 plots	Iron: 28 experiments 448 plots	Yield: 13 experiments 208 plots
	Pecent	Percent	Percent	Percent
N	—12.4	— 1.1	—17.9	+50.7
P	— 1.6	+10.0	— 2.1	+ 1.3
K	— .2	— .8	— 1.3	+ 8.6
Ca	+ 2.1	+ 1.0	— 1.7	+ 2.3

Table 2. Average calcium, phosphorus, and iron content of turnip greens from the NPKCa and check plots for each station and for 30 experiments.

Stations	Number of experiments	NPKCa plots			Dry basis		
		Dry basis			Check plots		
		Calcium	Phosphorus	Iron	Calcium	Phosphorus	Iron
		Percent	Percent	Percent	Percent	Percent	Percent
Georgia	5	2.39	.5690	.0247	2.99	.5182	.0417
Mississippi	9	2.44	.5794	.0187	2.92	.5705	.0221
Oklahoma	6	2.92	.5749	.0251	3.26	.5104	.0271
South Carolina	3	2.48	.5774	.0169	2.54	.5437	.0198
Texas	4	2.35	.6119	.0157	2.43	.5698	.0145
Virginia	3*	2.73	.6010	.0368	2.97	.4413	.0430
Average	29	2.55	.5745	.0215	2.90	.5307	.0277

*The iron data were averages of two experiments in Virginia.

60 pounds per acre of N from ammonium sulfate, 60 pounds per acre of P_2O_5 from triple superphosphate, 60 pounds per acre of K_2O from muriate of potash, and 120 pounds per acre of Ca from gymsum. In all localities a relatively poor soil was selected in order to study the effects of the fertilizer treatments. The majority of the soils were deficient in both nitrogen and phosphorus, and about one third of them were deficient in calcium. The greens from every experiment were harvested at a mature stage, and samples were analyzed from each of the 32 plots constituting one experiment. Samples of the soil were also analyzed. Yield records were taken from 13 experiments.

Effects of fertilizer treatments. The data from all experiments were combined and analyzed statistically. Twenty-nine of the 30 experiments were included in the results on calcium and phosphorus and 28 experiments in the results on iron, because of incomplete data from the experiments which were omitted. The average effects of the four fertilizer factors, N, P, K, and Ca on the calcium, phosphorus, and iron content of the greens are shown in table 1. By means of the statistical analysis, it was possible to determine the effects of each of the factors whether each was added singly or in combination with one or more of the other three factors. For example, in each experiment there were 16 plots to which nitrogen was added out of a total of 32 plots. The total number of plots for nitrogen in 29 experiments would therefore be 16 x 29, or 464 plots.

Of the four fertilizer factors studied, the application of nitrogen had the greatest effect on the mineral content of the greens. It decreased the calcium in 28 out of 29 experiments, and the iron in 26 out of 28 experiments. This decrease was statistically significant for calcium in 24 experiments, and for iron in 14 experiments.

When results are statistically significant there is little probability that they are due to mere chance. Nitrogen also reduced the phosphorus content of the greens in 18 experiments, the reduction being significant in 12 of them. The effect of nitro-

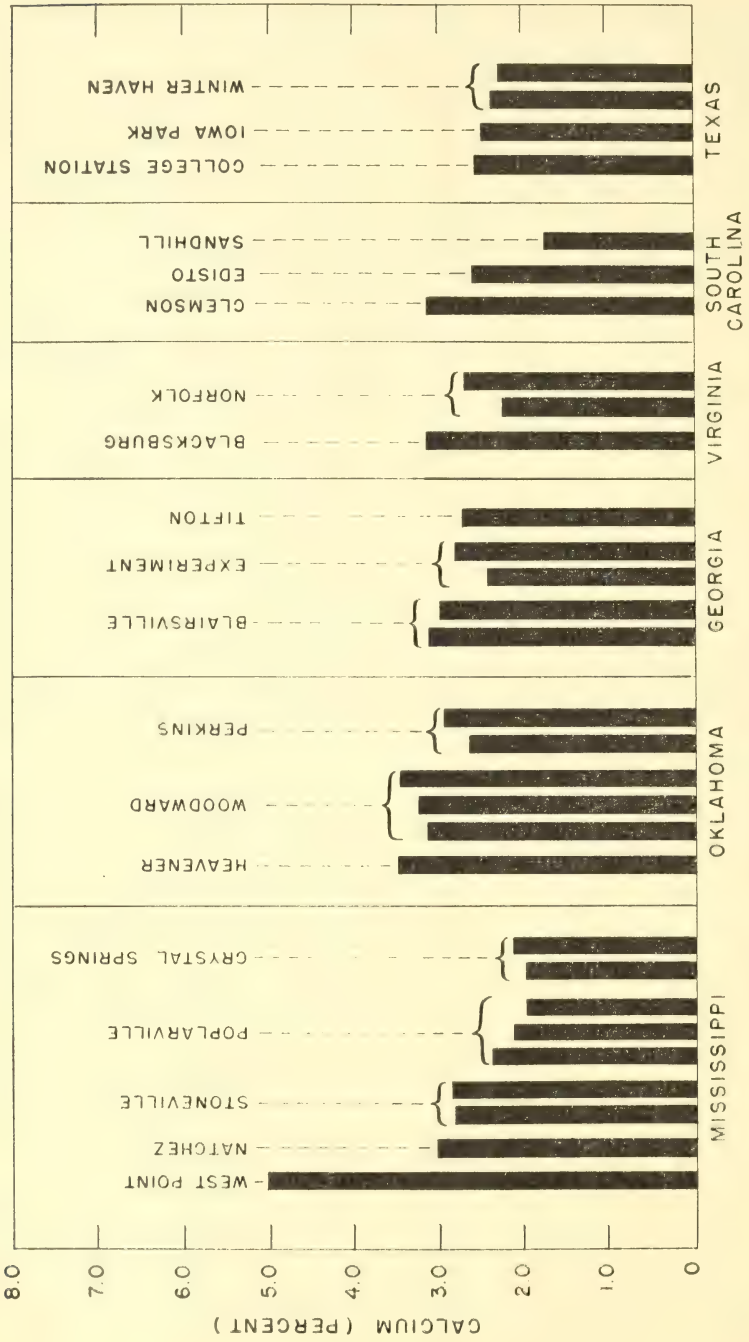

Figure 1. Average calcium content in each of 30 crops of turnip greens.

gen on the phosphorus in the greens was, however, less consistent than its effect on calcium and iron, as there were six experiments in which it increased the phosphorus.

Phosphorus, when applied to the soil, increased the phosphorus content of the greens in 27 out of 29 experiments, and significantly in 18 of them. There was an over-all tendency, however, for applied phosphorus to decrease both the calcium and the iron in the greens, although its effects varied in different localities and in different seasons.

The addition of calcium to the soil increased the calcium content of the greens in 20 experiments, but significantly in only four of them. Calcium also tended to increase the phosphorus, but the increase was significant in only three experiments. Calcium had no significant effect on the iron in the greens.

The effects of adding potassium varied with the experiment and were not consistent.

In the 13 experiments in which yield records were taken, nitrogen had the greatest effect, increasing the yield in 8 of the the 13 experiments.

In most instances, as will be seen from table 1, the effects of the fertilizer treatments were relatively small, and therefore could not be regarded as important from a dietary standpoint. The largest effects for minerals were those of nitrogen on the calcium, phosphorus, and iron in the greens, calcium and iron being reduced significantly. The actual reduction averaged about 12 percent of the calcium, 18 percent of the iron, and 1.1 percent of the phosphorus found in the greens from the check plots. Nitrogen had an important effect on yield, increasing it 72.71 grams (2½ ounces) per foot of row. This was an increase of more than 50 percent over the average yield from the check plots.

It would seem that the increase in yield caused by nitrogen might account for the decrease which it produced in the mineral content, since the minerals taken up by the plant would be distributed in a greater quantity of plant tissue. The statistical analysis indicated that this was the case.

In view of the fact that most of the soils upon which the greens were grown were deficient in nitrogen and phosphorus, and some of them in calcium, it is interesting to compare the mineral content of the greens from the plots to which all four fertilizer factors were added, with the mineral content of the greens from the plots which received no fertilizer. The results for the average calcium, phosphorus, and iron content of the turnip greens from the NPKCa and check plots, for each station and for the 30 experiments, are given in table 2.

It will be seen that the greens from the check plots contained more calcium at every station than those from the NPKCa plots. The same was true for iron with the exception of the Texas plots. The check plots contained less phosphorus, however, than the NPKCa plots. Averaging all experiments, the greens from the check plots contained 13.7 percent more calcium, 28.8 percent more iron, and 8.2 percent less phosphorus than the greens from NPKCa plots. Thus the average effect of increasing the fertility of the soil by the addition of four fertilizer factors, two of which were known to be deficient in the majority of the soils, was an actual decrease in the nutritive value of the greens with respect to calcium and iron, and only a small increase in phosphorus.

Effects of soil constituents. The question arises as to the effects of the soil constituents in the original soil on the mineral content of the greens, and the ways in which the fertilizer treatments might modify these effects. In order that this question might be studied, the soils were analyzed before fertilizer was added. They were classified into low,

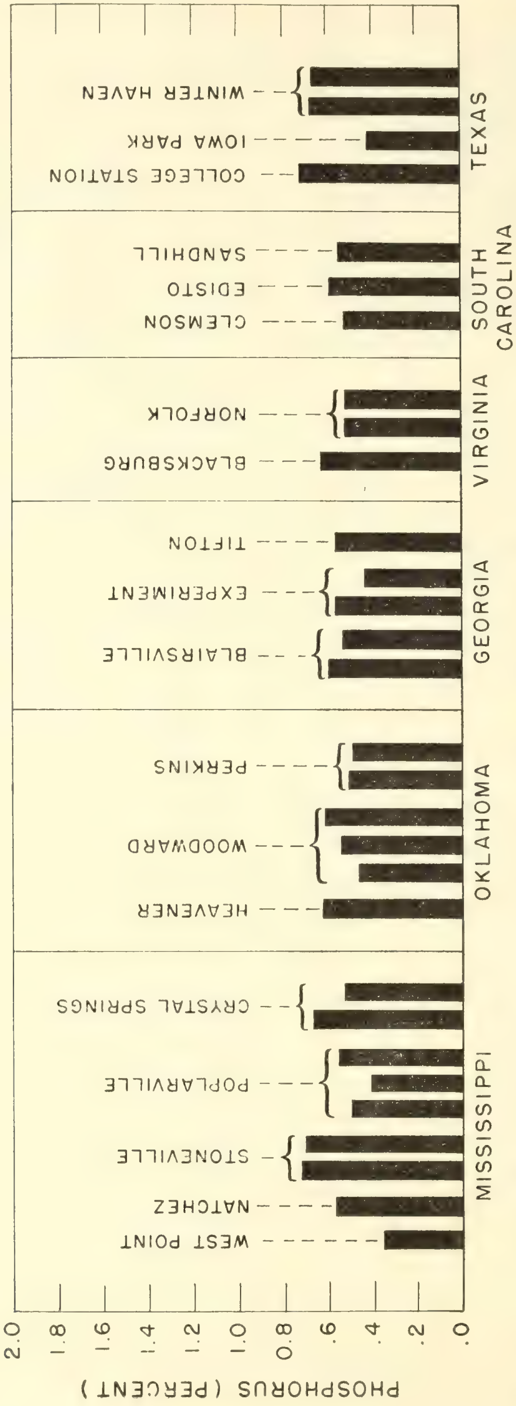

Figure 2. Average phosphorus content in each of 30 crops of turnip greens.

medium, and high with respect to their content of three important soil constituents, namely, calcium, phosphorus, and organic matter. Using this classification, the data from the check as well as from the fertilized plots were studied, and the average effects of the soil constituents determined. The results on the check plots were as follows:

It was found that the calcium in the greens increased as the soil calcium increased. The same was also true for phosphorus. Organic matter had little effect on calcium and phosphorus, but did have an important effect upon the iron content of the greens. The iron increased with increased organic matter. The greens grown on the high organic matter soils averaged over two and a half times as much iron as those grown on the low organic matter soils. Neither soil, calcium, or phosphorus affected the iron in the greens.

It should be kept in mind, however, that the results just described were obtained on the unfertilized plots. Since the majority of the soils were poor, fertilizers would have been added, particularly nitrogen, if good agricultural practices were followed.

The results on the fertilized plots were similar to those obtained on the same plots for the 29 unclassified soils. Nitrogen again had the most marked effect, decreasing the calcium, phosphorus, and iron in the greens. This occurred at all three levels of the soil constituents for calcium and iron, but nitrogen decreased phosphorus only in the low phosphorus soils, of which there were 22. In general, soil constituents had a greater effect on the minerals studied than did the added fertilizers. It should be pointed out, however, that with regard to calcium and phosphorus, this may have been due to the difference in the soil levels of these two minerals as compared with the amounts in the fertilizer. For example, the differences in the high and low calcium soils amounted to about 2,000 pounds per acre, as compared with 120 pounds added as fertilizer.

Effects of climatic conditions. In field studies it was not possible to separate the effects of the various factors associated with climate and weather, such as temperature, light, humidity, and rainfall. It was possible, however, to study seasonal and yearly differences in the mineral content of greens grown at the same place, since they were grown on the same kind of soil, and received the same fertilizer treatments. The largest differences were in iron content.

Table 3 shows the average percent of iron in the greens from N, P, K, Ca, and check plots, in which the seasonal or yearly difference in greens grown at the same place was 50 percent or more. These plots were selected, since the effects of a combination of fertilizer factors added to the soil did not enter into the variation, as would have been the case if more than one factor had been added. It will be seen that in some instances the seasonal variation was greater than that between places, and that the spring greens contained about twice as much iron as the fall greens. A comparison of the average iron content of the spring and fall crops in 29 experiments disclosed that of the 14 crops having the higher iron content, only one was grown in the fall. However, the study did not extend over a long enough period and the data were insufficient to obtain conclusive results. While the data were insufficient to make a complete study of the effects of season on mineral content, they indicate that variations due to season or climate might more than offset variations due to soil.

The effect of place. By far the greatest differences found in the mineral content of the greens were associated with the place where they were grown. This is brought out in figures 1, 2, and 3. Figure 1 shows the average calcium,

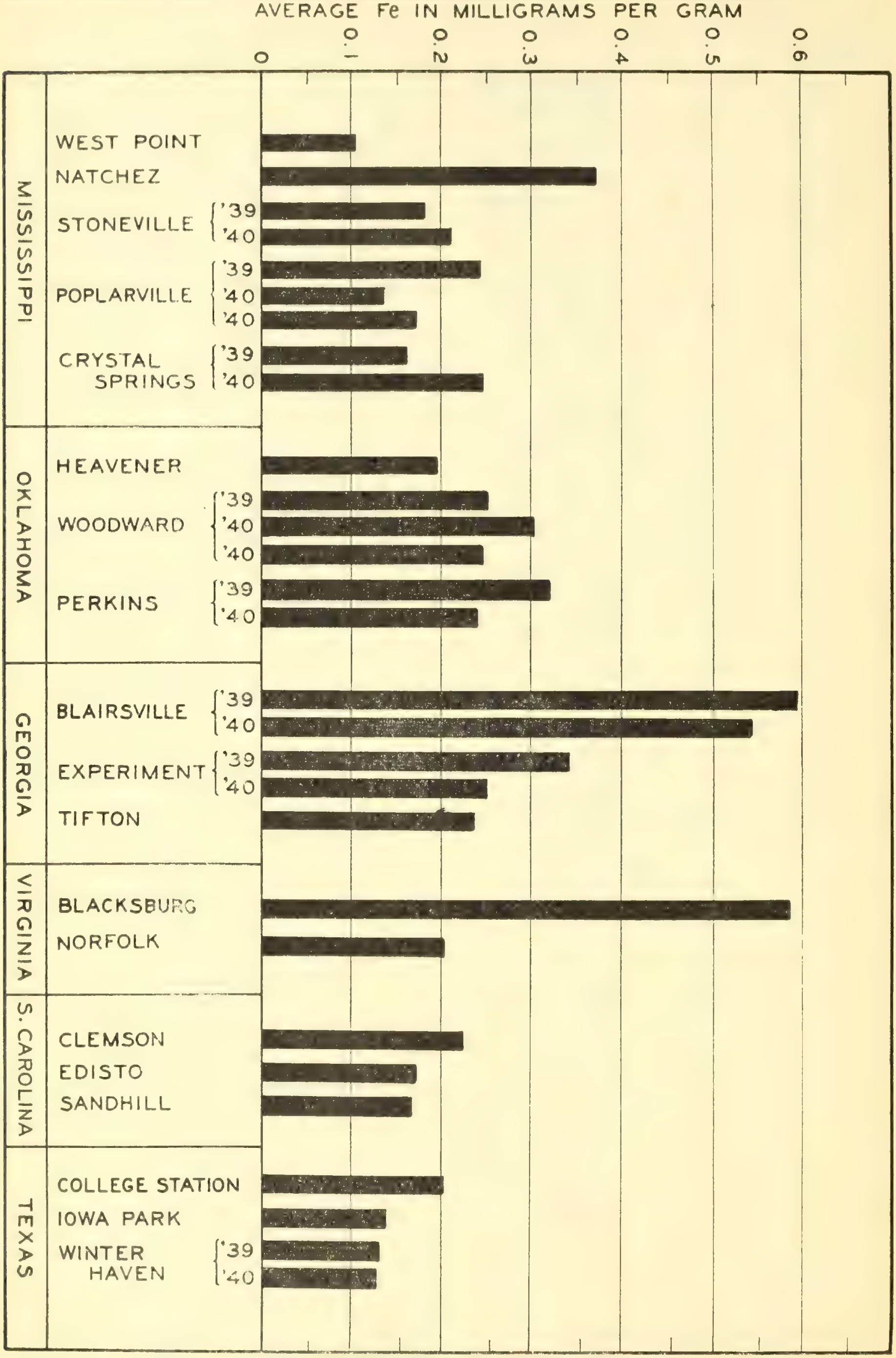

Figure 3. Average iron content in each of 29 crops of turnip greens.

figure 2 the average phosphorus content of the greens in each of the 30 crops, and figure 3 shows the average iron content in each of 29 crops, for all fertilizer treatments.

The greatest variation occurred in the iron, and the least variation in the phosphorus content. The range for the average percent of calcium in the 30 crops was 1.74 percent at Sandhill, South Caroline, to 5.08 percent at West Point, Mississippi, and the range for phosphorus from .3531 percent at West Point, Mississippi, to .7203 percent at Stoneville, Mississippi. The iron content in each of the 29 crops varied from .01052 percent at West Point to .05985 percent at Blairsville, Georgia.

It seemed that variations in yield between different places might account for the variations in the mineral content of the greens. A statistical analysis of the data showed, however, that this was not the case.

In comparing the Ca, P, and Fe content of the greens from the different places, it will be noted that greens which were high in one mineral might be low in one or both of the other two minerals. The most outstanding example of this was the West Point greens. The greens from Blairsville and Blacksburg, however, were exceptionally high in iron and a little above average in calcium and phosphorus.

It is evident from the experiments on turnip greens that there were many factors responsible for the large variation in the mineral content of the greens grown in different places. Soil composition is only one of these factors, and in many instances may have had less influence than a combination of other factors.

Mississippi Studies on Leafy Vegetables

Studies were made on several vegetables by the Home Economics Department of the Mississippi Experiment Station, most of them previous to the cooperative studies. While these studies were preliminary in nature, the results seem worth reporting in view of the results obtained from the cooperative studies.

Experiments on mustard and turnip greens. Mustard and turnip greens from the same lots of seed were grown at three branch stations in Mississippi in the spring of 1928. The greens were to be harvested at 7, 8, and 9 weeks after the planting dates, but all three harvests were made only at Poplarville (table 4). All lots of greens were analyzed for iron. Yield records were not taken, but the condition and growth of the plants were carefully noted. Table 4 shows the iron content of the greens harvested at 7, 8, and 9 weeks, for all samples which were secured. It will be noted that the poorly grown greens from Stoneville and

Table 3. The average iron content of turnip greens from 5 plots (N, P, K, Ca, and check) grown in different seasons or years at the same places. (The results are limited to those where seasonal or yearly differences at the same place are 50 percent or more.)

Place	Year	Season	Average content of iron (dry basis) from duplicate plots fertilized with:				
			N	P	K	Ca	Check
			Percent	Percent	Percent	Percent	Percent
Experiment, Ga.	1939	Spring	*	*	*	*	.04348
	1940	Fall					.02198
Crystal Springs	1939	Fall	.01440	.01613	.01911	*	*
	1940	Spring	.02392	.03250	.03070	*	*
Poplarville	1939	Spring	.02397	.03120	.02274	.02915	.02913
	1939	Fall	.01349	01380	.01461	.01395	.01444
	1940	Spring	*	*	*	*	.01873

*Difference less than 50 percent.

Table 4. Iron content of mustard greens and turnip greens from the same seed grown at three places in Mississippi.

Place	Vegetable	Condition of vegetables	Percent iron dry basis at: 7 weeks	8 weeks	9 weeks
Poplarville	Mustard	Very well grown	.03927	.03138	.02330
	Turnip greens	Very well grown	.03859	.02659	.02758
Raymond	Mustard	Poorly grown	No sample	.03750	No sample
	Turnip greens	Poorly grown	No sample	.04017	.05494
Stoneville	Mustard	Poorly grown	.08050	.08333	No sample
	Turnip greens	Poorly grown	.06717	.05160	No sample

Table 5. The results of soil analyses showing the percentage of 8 constituents in the three soils in which mustard and turnip greens were grown.

Place	Soil constituents (dry basis): Iron oxide	pH	Organic & volatile matter	Calcium oxide	Magnesium oxide	Potassium oxide	Phosphoric acid	Nitrogen
Poplarville	1.79	4.4	2.21	0.30	0.37	0.42	0.07	0.05
Raymond	3.17	5.2	3.68	0.27	0.17	1.60	0.06	0.10
Stoneville	4.24	6.2	6.20	1.02	0.94	1.74	0.16	0.14

Raymond had a higher iron content than the well grown greens at Poplarville.

The soil analysis indicates that both the Stoneville and Raymond soils, particularly the former, were more fertile than the Poplarville soil (table 5), yet the Poplarville greens were succulent and of excellent quality in contrast to the greens from Stoneville and Raymond, which were stunted and tough. Information on rainfall was not obtained and it may have been an important factor influencing the growth of the plants. The results show, however, that potentially fertile soils may produce inferior vegetables, while much poorer soils may produce superior vegetables with respect to eating qualities. They also show that a well grown vegetable may be inferior in nutritive value, at least with regard to iron, to a poorly grown vetgetable. The growth of a vegetable is, therefore, not necessarily a criterion of its nutritive value.

Experiments on spinach and tendergreens. Nitrogen fertilizer experiments on spinach and on tendergreens were carried out on the same soil in the spring, but in different years, by the Horticulture Department. Soil analysis as well as the growth of crops in the same place in previous years had demonstrated that the soil was fairly fertile. It was not deficient in available minerals, including calcium, phosphorus, potassium, and manganese, although the addition of nitrogen improved production considerably in the early spring crops because the low soil temperatures made the nitrogen less available to the plants.

The Home Economics Department was interested in the effect of the nitrogen on the mineral content of the greens, so samples of the vegetables were taken for analysis from the high nitrogen and the check plots. The samples were analyzed for calcium, phosphorus, iron, and nitrogen. The results of the analyses are shown in table 6. The data on nitrogen are included, since it was thought the results might be of interest.

In all three experiments, although the vegetables were grown in different years, the plants from the plots which received no nitrogen contained more calcium, phosphorus, and iron than those from the high nitrogen plots. With respect to nitrogen, the differences between the no nitrogen and high nitrogen plots were very small in two experiments, although it is the general observation that the application of nitrogen increases the nitrogen content of plants. Data on yield were secured only from the experiment on tendergreens. The yield from the high nitrogen plots was nearly ten times that from the no nitrogen plots. Yield differences between the high nitrogen and check plots in the two experiments on spinach would doubtless have been even greater, since there was a greater difference in the sizes of the plants from the two plots.

In these experiments on spinach and tendergreens the effects of the application of nitrogen on calcium and iron content and upon yield are in accordance with the results obtained in the cooperative experiments on turnip greens. They also give further evidence that poorly grown plants may have a higher mineral content than well grown plants.

Studies on Cowpeas

A study similar to that on turnip greens was conducted on cowpeas.[3] Peas of the same variety (Cream Crowder) and from the same seed source were grown in 22 locations in five of the six states where the turnip greens were grown. The places of the experiments and the fertilizer treatments were the same as those for turnip greens.

A study of the average calcium, phosphorus, and iron content of the cowpeas from each experiment showed much less variation in mineral content than was found for turnip greens. The range in calcium content was .063 to .100 per cent; in phosphorus content, .367 to .590 percent; and in iron content, .0040 to .0079 percent. As in turnip greens, iron showed the greatest variation.

The fertilizer treatments had less effect on the calcium and phosphorus content of cowpeas than on that of turnip greens. In eight out of the 21 experiments for which complete data were secured, the calcium and phosphorus in the cowpeas was neither increased or decreased significantly by the addition of fertilizer.

Adding fertilizer to the soil affected the iron more than it did the calcium and phosphorus in the peas, since there were only four experiments in which no significant effects of fertilizer on iron were observed.

The effects of fertilizer, however, varied so much with the experiment and place where the cowpeas were grown that there were no outstanding effects of any one fertilizer treatment on mineral content. as was the case with turnip greens. Nitrogen, however, decreased the calcium, phosphorus, or iron content of the peas in more experiments than it increased them.

Summary of Other Investigations On Minerals

In a review of recent literature entitled, "The Effect of Mineral Supply on the Mineral Concentration and Nutritional Quality of Plants,"[4] Beeson points out that very few studies in this field have been made on human foods. The majority of such studies have dealt with forage crops. Although in many instances the results were conflicting, Beeson was able to arrive at some general conclusions, most of which are included in the following summary:

1. The amounts of phosphorus in most forage plants can be increased slightly by the use of phosphate fertilizers. The evidence indicates that the effect of applied phosphates on the phosphorus content of plants is largely dependent on the nature of the soil.
2. The effects of applied nitrogen on the phosphorus in the plant are variable.
3. Adding calcium to the soil decreases plant phosphorus under some conditions and has no effect under others. This is probably due to the nature of the soil.
4. In general, applied calcium increases the calcium in the plant, although plant species and soil conditions modify its effect.
5. The effect of nitrogen in reducing plant calcium has been confirmed in many kinds of plants and under widely variable soil conditions.
6. The effects of potassium fertilization on phosphorus content of plants were variable and not significant, but potassium

generally reduced the percentage of calcium in the plant.

7. The number of soil experiments in which the effects of micronutrients (boron, cobalt, copper, manganese, iron) have been studied are so few that no conclusions can be drawn as to their influence on the composition of the plant.

The effects of applied phosphorus, calcium, nitrogen, and potassium, as stated in the foregoing conclusions, agree on most points with the results of the cooperative experiments on turnip greens.

Studies on Vitamins

Many investigators have studied the effects of fertilization and other factors on the vitamin content of plants. These studies have dealt chiefly with vitamin C and carotene, the form in which vitamin A exists in plants. As in mineral studies, the findings have frequently been conflicting partly because different plants were studied, partly because the experiments were not carried out under the same conditions, and partly because all factors were not, or could not, be controlled.

Cooperative Experiments. Three of the 6 stations which cooperated in the study on the mineral content of turnip greens, made a study of vitamin C content as well.[5] At these stations, the same samples were used for both mineral and vitamin studies. Samples were analyzed for vitamin C from four localities: two in Virginia, one in Georgia, and one in Oklahoma. Of the four fertilizer factors, N, P, K, and Ca, only nitrogen and potassium had a significant average effect when data from the four places were combined.

Although the average effect of nitrogen was to decrease the vitamin C content of the greens, there was a significant increase at one place. Potassium decreased the vitamin C in the greens in all four places and significantly in three of them. The greens were grown on different types of soil at the four places, but in this study no differences in vitamin C content could be attributed to the soil with the data which were available.

As in the case of minerals, the greatest variation in vitamin C was associated with the place where the greens were grown. A study of weather conditions indicated that sunshine might have had an important effect on the vitamin C content of the greens, since those from the two experiments giving the highest content were produced during periods when there was the most clear weather.

Experiments at the Mississippi Station. In field experiments on turnip greens harvested at 2-week intervals, considerable variation in the vitamin C content of the greens was observed for the different harvests. As this variation did not seem to be due to plant maturity, it was thought that it might be explained by weather conditions, particularly with reference to light, since it is known that light has an important influence on the formation of vitamin C in plants.

To study the effect of light under field conditions, an experiment was conducted on another plot of turnip greens planted in a row 2-3 feet wide. A 5-foot portion of the row where the growth of the greens was uniform was shaded with canvas for 4½ days. At the end of this time samples of the shaded greens, as well as the unshaded greens just beyond each end of the shaded portion, were taken. The leaf blades were analyzed for vitamin C.

Table 7 shows the results of this analysis. It will be noted that shading the greens with canvas for only 4½ days caused considerable reduction in vitamin C content. The two samples of unshaded greens differed little in the amount of vitamin C found, but averaged over 31 percent more than the shaded greens. During the 4½ days of the experiment, the second day was partly cloudy and the other days were clear. The greens were harvested at 1:00 p. m.

The experiment was conducted in No-

Table 6. Effect of nitrogen supply on the calcium, phosphorus, iron, and nitrogen content of spinach and tendergreens grown at the Mississippi station.

Experiment	Date of harvest	Fertilizer treatment $NaNO_3$	Appearance and size of plants	Percent dry basis			
				Ca	P	Fe	N
		lbs. per acre					
1. Spinach							
High nitrogen	Mar. 26&31,'37	364	Large, dark green	.80	.630	.02150	3.55
No nitrogen	Mar. 26&31,'37	None	Very small, yellow	.87	.830	.03423	3.39
2. High nitrogen	Apr. 16, '41	583	Very large, dark green	.90	.533	.01665	4.88
No nitrogen	Apr. 16, '41	None	Very small, yellow	1.05	.701	.01958	4.04
3. Tendergreens							
High nitrogen	May 7, '40	600	Very large, dark green	2.11	.542	.01083	4.52
No nitrogen	May 7, '40	None	Smaller and lighter green than high N plants	2.45	.617	.01178	4.37

Table 7. Effect of shading on vitamin C content of turnip greens grown in the field.

Shade treatment	Moisture	Vitamin C—mgs. per 100 grams	
		Moist basis	Dry basis
Canvas	90.0	75.33	753.3
Unshaded—South End	85.6	154.20	1070.0
North End	86.2	156.28	1132.5

vember but had it been carried out at a time of year when light intensity is greatest, the difference in vitamin C content between the shaded and unshaded greens might have been even larger. The results indicate that in a short period of time just before harvest, weather conditions may have an important effect on the vitamin C concentration in plants.

That soil conditions are also important was suggested from an observation made on the same plot of turnip greens. It was noticed that the plants at one end of the row, extending a distance of 5 or 6 feet, were considerably smaller and less green than those in the remainder of the row. The soil deficiency which caused the stunting was not determined. Typical stunted plants were removed and samples of the leaf blades analyzed for vitamin C at the same time the other samples were taken.

The amount of vitamin C found in the stunted plants was 215.44 milligrams per 100 grams on the fresh basis, and 1313.7 milligrams on the dry basis. The average for the well grown greens (unshaded samples) was 155.24 milligrams on the fresh basis and 1101.6 milligrams on the dry basis. This observation that stunted plants may contain more vitamin C than well grown plants of the same kind is in accord with the results reported in the cooperative experiment on turnip greens since nitrogen fertilization increased yield or plant growth, but decreased the vitamin C content of the plants at most places.

Other Experiments. While some investigators have found that nitrogen fertilization increased the ascorbic acid content of plants and others that it had no effect, a number have reported results in agreement with those of the cooperative and the Mississippi studies. There has been general agreement as to the effect of light.

Albrecht, with two coworkers, in experiments on Swiss chard and spinach,[6] reported a decrease in the concentration of vitamin C, but an increase in yield with increasing quantities of nitrogen applied as fertilizer. In a review of the literature, they cite other experiments in which the vitamin C concentration in unfertilized spinach and in tomatoes was higher than that in the fertilized vegetable, particularly when nitrogen alone was used. Fertilization studies with apples and grapefruit have also given results similar to those on vegetables. The fruit from trees which were not fertilized or received a low supply of nitrogen had a higher concentration of vitamin C than fruit from the fertilized trees.

Apparently, decreased growth of plants resulting from a variety of conditions may cause an increase in the concentration of vitamin C. This has been observed not only when there was a lack of nitrogen, but also when there was a lack of iron and magnesium. Decreased growth due to dry weather may also result in an increase in vitamin C in plants. A part of this increase, however, is due to sunshine.

The effect of light intensity on the vitamin C content of turnip greens has been studied.[7] Turnip greens which had been grown in pots were placed in a special chamber and exposed 16 hours daily for one week to various light intensities. The intensities varied from 200 to 5,000 foot candles. The vitamin C content of the leaves increased as the light intensity increased. The greens which were exposed to an intensity of 200-foot candles contained 28.2 milligrams of vitamin C per 100 milligrams of fresh weight while those which were exposed to a light intensity of 5,000-foot candles contained 235.5 milligrams, or over eight times as much. This experiment shows that the intensity of light which varies with the climate, the season, and the kind of day is a very important factor influencing the vitamin C content of plants.

The influence of variety or strain on the amount of vitamin C found in vegetables and fruits has been studied by a number of investigators. While environment or the place where the plant was grown had considerable effect on vitamin C content, the effect of variety was usually greater than that of other factors related to the environment such as climate or soil and fertilization.

Carotene and Other Vitamins

The cooperative experiments on turnip greens and those made at the Mississippi station did not include carotene and other vitamins, although experiments are in progress which do include them. A summary of the results of other investigations will, therefore, be given.

In a number of studies, some of them quite recent, fertilization with nitrogen has been found to increase the carotene content of the plants. Other studies, however, report no effect on carotene from the use of nitrogen. The results of experiments in which various fertilizer treatments were tried indicated that fertilization had little effect on the amount of carotene in the plant. These experiments included extensive studies on tomatoes and turnip greens.

Experiments in which boron was added to the soil have, however, given more consistent results. The application of boron has been found to increase the carotene content of plants grown on a boron-deficient soil.

Some studies on tomatoes have been reported which indicate that light affects the carotene content of plants, as tomatoes grown in the green house had less carotene in them than tomatoes grown out of doors.

As has been pointed out, the majority or vitamin studies have dealt with the effects of fertilization and other factors on the carotene and vitamin C content of plants. This is due to the fact that chemical methods for the determination of the other vitamins have been developed more recently and the results of analysis are less reliable.

Most of the studies on other vitamins have been made on cereals. The amounts of B_1 (thiamine) in the same kinds of cereals have been found to vary with the variety and the place where they were grown, but this was not true of B_2 (riboflavin). There is little evidence that fertilizers have an important effect upon either the B_1 or the B_2 content of wheat.

The niacin (pellagra-preventing vitamin) content of foods is of particular interest in the South. Recent studies on corn varieties and strains indicate that variety may be one of the most important factors influencing the niacin content of cereals.

Summary on Vitamins

The vitamin content of plants is influenced by many factors which include variety and strain, soil and fertilizers, climate and weather conditions.

The results on the effects of fertilizers are conflicting but there is evidence that under some conditions they may have a significant effect upon the vitamin C and carotene content of plants. This is particularly true of nitrogen which in several studies has been found to decrease the amount of vitamin C but increase the amount of carotene.

Factors affecting the growth of plants also affect the concentration of vitamin C. Stunted plants are apt to contain more vitamin C than well grown plants.

Experiments have demonstrated that conditions associated with climate and weather, particularly light intensity, have a very important effect on the vitamin C content of plants, and influence their carotene content.

Studies have shown that variety and strain may have a greater influence on the vitamin C, B_1, and niacin present in foods of plant origin than the environment in which they were produced.

Discussion of the Relation of Soil Fertility and Other Factors to the Nutritive Value of Plants

The estimation of the nutritive value of foods, including those of plant origin, is usually based upon their composition as determined by chemical analyses. This is due to the fact that biological tests (animal feeding experiments where the food is fed under controlled conditions) are very time consuming, laborious, and expensive, although the best means of investigating the nutritive value of foods. It has been found that on the whole the results of chemical analysis agree fairly well with the results of biological tests. In this discussion, judgement as to the nutritive value of a food is based upon the results of chemical analyses.

From the information which has been given concerning the influence of various factors on the mineral and vitamin content of foods of plant origin, it is evident that soil fertility is only one of many factors. It is also evident that the many factors working at the same time, and affecting each other make it very difficult to determine the actual effects of soil fertility on the nutritive value of foods. Extensive and very carefully controlled experiments are necessary and few of these have been made. It has been shown that factors other than soil, such as variety, and climatic or weather conditions may be more important than soil fertility in influencing the amount of certain nutrients in plants. It cannot be said, therefore, that the amounts of these nutrients depend upon soil fertility alone.

It has also been shown that when soil fertility is improved by the addition of nitrogen and other fertilizer factors so that the plants make better growth, the concentration of certain nutrients, such as calcium, phosphorus, iron, and vitamin C, may actually be reduced. Thus, poorly grown plants which are the result of soil deficiencies may have a higher nutritive value on the whole than well grown plants not suffering from these deficiencies. This does not support the common assumption that poor soil produces plants of lower nutritive value than good soil.

It may be concluded that evidence is lacking to show that the nutritive value of plants is chiefly dependent upon soil fertility.

Animal Feeding Experiments

As Beeson points out, most animal feeding experiments in which the effects of pasture fertilization are studied show only the effects of pasture improvement resulting from increased yield and the introduction of more nutritious species of plants. The increase in production of animal products per acre is used to measure the effects of fertilization. No study is made to show how fertilization influences the nutritive value of the same kinds of plants.

Studies in which biological tests were used to measure the effects of soil fertility have been reported by Albrecht and co-workers.[8 9 10] Animals (lambs and rabbits) were fed hay crops produced on soil fertilized with superphosphate and lime and their growth compared with that of animals fed hay from untreated soils. The animals fed the hay from the fertilized soil made the best growth. It was concluded that such hay was superior to that grown on the untreated soil, even though little difference was found in the chemical composition of the two hays when analyzed for nitrogen, calcium, and phosphorus. The assumption was that there were nutritional differences in the two hays not shown by the chemical analyses. The experiments of Albrecht and co-workers have been criticized in the following respects:

1. In the earlier studies they failed to take into account possible variations in the kinds of plants present in the two hays.

2. Although chemical analyses failed to show nutritional differences, no experiments were made to determine the digestibility of the two hays.

3. The differences between the gains in weight of the two sets of animals were very small; and it was not demonstrated that this difference was statistically significant.

4. In some of the experiments only three animals were used, although a minimum of six to eight is usually regarded as necessary, since there is considerable variability in the way in which different animals respond to the same feed, even when they are carefully selected for uniformity.

Table 8. Number of white families on poorer and better soil not having specified foods in February, July, and November when 2-day menus were taken.

Families not having	Poorer soil	Better soil
	Number	Number
Milk		
February	21	8
July	3	4
November	4	1
Meat or eggs		
February	9	2
July	20	7
November	51	20
Milk, meat or eggs		
February	2	1
July	1	0
November	2	0
Vegetables or fruits		
February	4	6
July	0	0
November	0	0
Number of families	125	125

Animal feeding experiments are also being carried out by investigators at the U.S. Plant, Soil, and Nutrition Laboratory at Ithaca, New York, in connection with studies to determine the effect of phosphorus on the nutritive value of plants. Two sheep feeding experiments have been completed.[11] In the first one, two lots of sudan grass hay produced on a low phosphorus soil in the same field fertilized with potash and nitrogen were tested for their nutritvie value. The two lots of hay differed only in that one lot had been fertilized with superphosphate in addition to potash and nitrogen. When the two lots were fed to lambs neither growth tests or digestion experiments indicated a difference in nutritive value. The second experiment in which Canada field peas were fed led to similar results.

The results of the Ithaca studies would seem to be contradictory to the observations that livestock in poor soil areas develop nutritional diseases because the soil in lacking in certain minerals and, therefore, the plants which the animals eat. It may be pointed out, however, that the forage eaten by the Ithaca animals differed in kind and amount from that which would be available to the animals in poor soil areas. The nutritive value of species of plants which will grow in poor soil is naturally low, the amount produced may be limited, and such species may have a low digestibility.

Human Dietary Studies

Many dietary studies have been made among rural people which show that low or very low income families usually have a deficient diet. In some instances, the physical condition of the people has been correlated with the diet. In no instances, however, have careful studies been made accompanied by studies showing the nutritional condition of the people in which one group living in a deficient soil area was compared with a similar group living in a good soil area.

Only one study has furnished definite information as to the kinds of food eaten by people living in different soil areas. This study entitled, "Family Living on Poorer and Better Soils," was made by the Home Economics Department of the Mississippi Station.[1 2]

Records of menus served by 125 white families were kept for two days in February, July, and November of one year. The foods were classified and the number of times they were not served were tabulated for the families living on poorer soil and those living on better soil. The results are shown in table 8.

The families living on poorer soils served milk, as well as meat and eggs, less often than those living on better soils. It was also found that families living on poorer soil produced less milk, meat, and other food than those living on better soils. Although dietary studies among the two types of families were not made, it may be inferred from the study of the menus and the food produced that the diets of the families living on poorer soil were inferior to those living on better soil.

Relation of Soil Fertility To The Diet of Humans

The scientific evidence now available does not confirm the belief that the nutritive value of the diet of humans living in deficient soil areas is directly related to the fertility of the soil. The locally produced foods which the people eat may be no less nutritious than the same kinds of food produced on fertile soil. The evidence which has been presented shows that this is true with regard to foods of plant origin. It is probably true also for foods of animal origin, although information on this point is lacking.

Experiments comparing the nutritive value of foods derived from poorly nourished animals with the nutritive value of the same kinds of foods derived from well nourished animals have not been made. It is known, however, that the composition of cows' milk with respect to fat protein, and mineral content is not greatly changed by the diet of the animal.

It seems most probable, therefore, that people living in poor soil areas are poorly nourished, not because of deficiencies in the plant and animal foods produced there, but because these people do not produce enough foods of the right kind. Their diets are apt to include too little of the protective foods—meat, milk, eggs, fruit, and green vegetables. Dietary studies dealing with poor rural people indicate this. Incomes are low, because of low production, and foods needed to supplement the diet are not purchased.

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The Production and Utilization of Kudzu

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STATE COLLEGE MISSISSIPPI

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The Production and Utilization of Kudzu

By **R. E. O'BRIEN** and **D. W. SKELTON**[1]

INTRODUCTION

Kudzu is reported to have been introduced into the United States from Japan in 1876. Being a perennial vine plant and having large leaves it was ideally suited for use on trellises to form a shade around homes. Its earlier popularity came from this use. Its value for erosion control and as a forage crop was not fully realized until rather recent years. During the past 30 years it has gained popularity rather rapidly and within the last 15 years its use has become widespread in the Southeast. Owing to its exceptional value for erosion control, it has been given great impetus by the Soil Conservation Service.

The large amount of gullied land and sheet-eroded slopes on many Mississippi farms has created a critical need for a plant that will grow vigorously enough under somewhat unfavorable soil conditions to check the loss of soil. There are also few perennial legumes well adapted to southern conditions that offer promise for hay and forage production on moderately low fertility soils.

Kudzu seems to fit remarkably well into these needs. In fact it has a number of qualifications that make it a valuable plant for many Mississippi farms. Its perennial nature offers certain advantages over the annual legumes. Being a vine that roots at the nodes gives it special merits for erosion control that can be found in few other plants. Its deep root system makes it more resistant to dry weather than most legumes.

The abundant production of large palatable leaves, relished by all types of livestock, gives it the necessary qualifications for being a good hay or forage plant. As a hay crop it has the unique characteristic of not having a critical stage of growth for cutting as is true of most hay plants if the best quality hay is to be obtained. A further advantage is that it is seldom bothered by insects or diseases.

The plant has one outstanding handicap, that has undoubtedly limited its use, in that it cannot be quickly and easily established from seed.

Kudzu has been used successfully by farmers in Mississippi and throughout the Southeast as a temporary pasture for various types of livestock for summer grazing when permanent pastures are in low production; as a leguminous hay crop, and as such it is comparable to alfalfa in feeding value; as a soil improvement crop on thin or eroded fields to bring unproductive soils back to a level of fertility necessary for profitable crop production.

Probably its most outstanding use so far has been for erosion control on steep, sheet-eroded slopes and gullied lands that have been mutilated to the extent that they are seemingly beyond further use for agricultural purposes. In this latter use kudzu has made an outstanding contribution.

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DESCRIPTION OF THE PLANT

Kudzu is a deep-rooted, vigorous, perennial legume with broad-leafed foliage, that grows as a vine rather than as an upright plant. It is a decidious plant and sheds its leaves after the first killing frost in the fall. The vines grow outward in every direction from the original plant and under ideal conditions attain a length of as much as 50 feet or more in a single season. At the nodes along the vines that are in contact with moist soil, roots are developed and new plants are originated. Gradually the vine connecting these new plants with the original one dies leaving the newly formed plants as individuals. These are called crowns and these crowns are a commonly used method of propagation.

The new plants in turn produce vines that spread over the surface and in this way kudzu spreads over an area until it completely covers the ground with a mass of interlaced vines that bind the soil in place and protect it from erosion. The abundance of leaves produced, if not otherwise used, is returned to the soil each fall, gradually decay, and enrich the organic content of the soil. The leaves are large and palatable and are relished by many types of livestock. If properly managed, they may be grazed during the growing season or cut for hay without injuring the stand or lessening its value for erosion control.

Kudzu produces rather large fleshy roots that are sometimes several inches in diameter. When undisturbed for several years the roots may penetrate to a depth of 3 feet or more under favorable soil conditions. The plant maintains itself by storing large amounts of starchy material in the roots, and from this stored reserve of food it starts its growth in the spring. If continuous grazing or frequent mowing is practiced without a rest period to allow the plants to store up this reserve of food in the roots, the vigor of the plants is reduced and the stand is gradually depleted.

There is considerable flowering in kudzu but a relatively small number of seed are set under conditions prevailing in the South. Where seed can be obtained, seedling plants can be produced and used in establishing a stand.

SOIL AND CLIMATIC ADAPTATION

Kudzu can be successfully grown on a wide range of soil types with only a limited number of exceptions. The most important requirement is that the soil have good internal drainage. Soils of light to medium texture—sandy loam to silt loam—are best. It does not make good growth on infertile sands or on poorly drained heavy clay soils. It is not well adapted to the heavy soils of the Black Belt and it should not be planted on soils containing a hardpan, or shallow soils in which bedrock is near the surface. The deep-rooted nature of the plant makes such soils unsuitable. Soils with these undesirable physical characteristics are of comparatively limited extent in the State, however, and therefore most farms contain land that is well adapted to kudzu.

The fertility of the soil is not a determining factor in where kudzu may be grown. However, like other leguminous forage crops, a moderate level of fertility is necessary for satisfactory growth. It has been strongly recommended and widely used on eroded land, areas where sheet-erosion or gullying have left the land unsuitable for row crops. It is an excellent plant for such areas, but proper fertilization is essential for satisfactory growth. Any soils that have been depleted of plant nutrients by cropping should be fertilized for the establishment of kudzu. It should be stressed that kudzu is not a plant that is best adapted to poor eroded soils; it is recommended for such areas because it will grow better under such conditions than most any other crop and therefore protect the land from erosion. Kudzu makes its best growth on fertile soils, and maximum production of forage for hay or pasture results from plantings on such soils.

Climatic conditions in Mississippi are ideal for the growth of kudzu. Maximum growth is made where the frost-free season is long and rainfall is ample and well distributed. Growth starts in the early spring and continues until the first killing frost in the fall. Periods of dry weather, while checking growth, have no serious effect on established stands because of the deep, well developed root system. Severe winter temperatures kill the vines back to the original plant but in Mississippi the vines normally survive the winter and continue to grow in the spring.

ESTABLISHING A STAND OF KUDZU

Since kudzu produces seed very sparingly and only a portion of those produced are viable, other methods of propagation—primarily the use of crowns and seedlings—have been most commonly used. This makes the establishment of a stand more difficult and somewhat more expensive than forage crops that are easily established from seed, and usually requires about two years time. The initial establishment of a stand is the most important aspect of a successful crop and therefore special attention should be given to proper preparation of the land, selection and handling of planting stock, fertilization and cultivation.

Methods of Propagation

There are four methods that may be used to establish a stand of kudzu: (1) crowns taken from a well established stand; (2) seedling plants produced in a nursery and transplanted to the field; (3) vine cuttings taken from a well established field; (4) seed planted directly in the field. The first two methods have been most commonly used. All methods of vegetative propagation should be done during the time that the plants are dormant.

Crowns

Vines lying in contact with loose, moist soil develop roots at the nodes (joints) and as the internodes of the vine gradually die these rooted nodes become independent plants and are called crowns. When the crowns have developed sufficient root system they can be dug or plowed up and used for new plantings. This method of propagation is very satisfactory and has been widely used. Various workers have made studies to determine what age and size of crowns are best for planting stock. Sturkie and Grimes of the Alabama Experiment Station (1) have found that 2-year-old or older crowns with a sound bud and well developed fleshy roots 8 to 10 inches long are most desirable. Moderately large crowns are more likely to live and produce vigorous plants than small ones. A good crown has at least one fleshy root one-half inch or more in diameter and at least six inches long, and one or more sound buds. Bruised or broken crowns should not be used. Where possible, crowns should be obtained locally so they can be set within a few hours after they are dug and the roots should be kept moist at all times. Crowns that are purchased from a seedsman should be heeled in moist soil as soon as received and planted as soon as possible. From an established field of kudzu the crowns may be obtained by deep plowing or digging with a mattock without serious injury to the stand. It is reported by Bailey (2) that an average of approximately 15,000 crowns can be obtained from an acre of well established kudzu. More crowns are usually produced on sandy soils than on clay soils.

Seedlings

The use of seedling plants is a satisfactory method of propagation. It involves particular care in producing the plants in nursery beds, and of course a source of seed must be available. Seed may be handpicked from vines that grow on some form of support that keeps them off the ground. Few seeds are produced on vines growing on the ground. Seed are borne in pods but the pods are often poorly filled. The seed are very small, there being 40,000 to 45,000 per pound. The seed coat is so hard that scarification is necessary for a satisfactory percentage of germination.

Seedling plants have been produced rather extensively by the Soil Conservation Service for use by cooperating farmers; and this organization has made considerable study of methods of producing plants in nursery beds. For farmers who have an available source of seed and wish to produce their own plants, the Soil Conservation Service has issued a mimeographed leaflet from the Regional Office at Spartanburg, South Carolina, suggesting the following procedure:

1. Select an area that is free of nut grass, wild onion and nematodes, and as free of crab grass and weeds as possible. A sandy soil that can be cultivated easily is preferable. Heavy clay soils that bake and crust following rains are not desirable. It is extremely difficult to get satisfactory stands on heavy soils. A red subsoil is desirable but not absolutely essential.

2. Break the land and harrow it thoroughly several weeks before seed is to be planted. Lay off deep furrows on the contour 30 to 36 inches apart. Apply 600 to 800 pounds of a complete fertilizer per acre in the furrows and bed on the fertilizer, at least two weeks before planting. Young kudzu seedlings are injured more easily by fertilizer than cotton plants. Drag the beds down almost flat and allow the soil to be well settled before planting.

3. Begin planting at cotton planting time. Freshen the surface of the beds with light harrow so as to get a surface seedbed such as would be desirable for planting small seeded garden vegetables. Plant 15 to 25 scarified seeds per linear foot of row (seed returned by nurseries is already scarified). Cover the seed approximately ¼ inch deep and press the soil firmly over the seed with a press wheel or some other type of roller.

4. Kudzu seedlings are very delicate and require hand weeding until they are large enough to be cultivated with a plow. A small garden plow can be used to good advantage in reducing the amount of hand weeding. Too much emphasis can not be placed on clean cultivation from the time the plants are up until they are large enough to produce runners and cover the ground.

5. If plants do not grow vigorously, it is advisable to side dress with nitrate of soda at the time of cultivation.

6. The quality of kudzu seedlings has been seriously damaged where the tops were mowed for hay during late summer or early fall. Do not remove any top growth until the seedlings are to be dug for transplanting.

7. In digging seedlings be sure to get as much as eight inches of sound undamaged root with each plant. Plants may be lifted with a round pointed shovel where only small quantities are produced. Where large quantities are to be dug, a plow that will go deep enough to get eight inches of sound roots may be used. After plants are dug, transplant them immediately to the field or heel them in carefully so as to avoid spoilage.

Vine Cuttings

That vine cuttings can be used as a means of propagation has been shown by various workers, although some difficulty has been encountered in obtaining a good stand. Sturkie and Grimes of the Alabama Experiment Station (1) reporting on a comparison between vine cuttings and crowns in 1939 found a much higher survival of crowns; from three dates of planting used for different types of planting stock February was preferable to December or April. The results of plantings in February from the use of various planting stock and methods of planting were as follows:

Crowns planted level with the surface of the ground, 77 percent survival.

6-foot vines planted with the terminal bud out, 48 percent survival.

6-foot vines completely covered, 21 percent survival.

2-node cutting with the terminal bud out, 16 percent survival.

From this investigation the Alabama workers advise that when using vine cuttings they should be of 5- to 6-foot lengths, dropped in furrows, and covered 2 to 3 inches in depth with the top end bud left uncovered.

Investigations made by Dr. G. W. Johnston of the Mississippi Experiment Station (3) in 1944 and 1945 resulted in an improved method of establishing kudzu from vine cuttings. The method involves the use of 2-node cuttings treated with a dilute solution of potassium permanganate which acts as a fungicide and also promotes root development. Johnston states that successful establishment by this method requires close adherence to a procedure involving thorough soil preparation, together with proper selection, treatment, and setting of the cuttings. Following is the procedure recommended by him for using vine cuttings.

Vines for cuttings should be carefully selected. The size of vines used should be those from pencil size up to one-half inch in diameter. Vines of a grayish-tan to tan color are more vigorous than dark brown or black ones. Those that appear even slightly dry or brittle or that show any internal discoloration when cut should not be used. Often the tip of the vine is injured by cold to the extent that it is not usable.

Proper handling at cutting time saves labor in later operations. Beginning at the tip and working back toward the attachment point, cut the vine into pieces having two nodes (joints) each having not more than three inches of vine extending below the bottom node of each cutting. The cuttings must not dry out; therefore containers of water should be kept on hand during the cutting. As fast as the cuttings are gathered stand them in 4 to 5 inches of water with the basal end of the cutting in the water and the top end (end toward the tip of the vine) up. It is a good practice to allow the cuttings to stand in water overnight, or at least for several hours.

The cuttings should be treated just prior to setting in a one-tenth of one percent solution of potassium permanganate (one ounce of permanganate dissolved in 7½ gallons of water makes the proper concentration). Place the cuttings in a container and pour in enough permanganate solution to cover the cuttings to a point at least two inches above the bottom node; or transfer the cuttings from water to a container of the solution, being sure that the basal 5 to 6 inches of each cutting is immersed. After a period of 20 minutes to one hour the cuttings should be removed from the solution and set immediately. The cuttings should not become dry between the time of treating and the time of setting. Leaving them in the solution for a period exceeding one hour is preferable to setting them while dry.

Seed

Low production of seed by kudzu and a relatively low percentage of germination of those produced has discouraged the use of seed as a means of propagation. An added disadvantage is that the seed must be handpicked from vines growing off the ground. In former years imported seed from Japan could be obtained on the commercial market. If the demand justifies it, this source of seed may again be used when trade relations are re-established with that country.

The hard seed coat characteristic of the kudzu seed make scarification essential for any appreciable percentage of germination. Several investigators have reported discouraging results even after scarification. McKee and Stephens (4) report as follows in U.S.D.A. Farmers' Bulletin 1923:

"Laboratory tests and field experience show that low germination of kudzu seed must be expected. Scarified seed usually germinates only 50 percent, and subsequent loss will so reduce the stand that only about a fifth of the germinable seed can be expected to become established nursery plants."

Experiments conducted in 1939 by Dr. H. W. Bennett of the Mississippi Experiment Station (5) gave excellent results from the use of sulfuric acid to treat the seed before planting. The acid removes part of the hard seed coat and thereby improves the germination. In the experiment concentrated sulfuric acid proved to be more effective than any rate of dilution. The seed were treated for 1, 3, and 6 minutes and the stand counts showed that germination was faster with those seed treated for six minutes. Maximum germination had been reached in 4 to 5 weeks. Unscarified seed gave a germination of 24 percent as compared to an average of 88 percent for the seed treated with concentrated sulfuric acid. Dr. Bennett outlines the following procedure for treating seed with acid and planting directly in the field:

"Place seed in a glass, earthenware, or wooden container. Pour in commercial sulfuric acid while stirring until the seed are well moistened. Continue stirring for three to six minutes. Pour onto a screen and wash well. Seed may then be planted or dried and planted. Prevent the acid from touching the body or clothing, as it may burn severely."

"The following directions should be followed in planting kudzu seed: lay off rows six feet apart by throwing two to four furrows on the row. This should be done three to four weeks before planting in order that a firm seedbed may be obtained. During the month of May form beds on the row at six-foot intervals. Plant 20 to 30 seed per hill and cover very lightly. Prevent crust from forming by scratching around the hill with a rake or hoe. When planted in this manner, one pound of seed is sufficient for one acre. The kudzu planting should be cultivated and hoed soon to be kept free of grass and weeds during the first year."

Soil Preparation, Planting, and Spacing

Thorough preparation of the soil is one of the most important considerations in the successful establishment of a stand of kudzu. The preparation is the same regardless of the type of planting stock to be used. It should be as thorough as for corn or any other row crop. Land that has been out of cultivation or that has grown foul with weeds should be plowed, and harrowed with a disk or spike-tooth harrow. Plowing should be deep, especially on the heavier soils to enable the roots to penetrate the soil. At least 30 days prior to planting the land should be bedded into rows to insure a firm, moist bed for planting. The width of rows will be governed by the plan of spacing and cultivation.

Planting of kudzu whether it be crowns, vine cuttings or seedling plants should be done during the dormant stage of growth, that is usually from December through February or early March. Various methods of planting have been used. Probably the most satisfactory but also the most time consuming is that of digging holes along the bed for each individual plant. Make the hole deep enough to allow the full extension of the roots, but avoid placing the roots in direct contact with fertilizer or manure that has been applied before bedding. Firm the soil around the plant from bottom to top leaving the bud slightly above the surface of the ground. This method of planting is made faster by opening a furrow in the bed with a bull tongue or small shovel.

Where treated vine cuttings are to be used as described earlier from Dr. Johnston's work the following procedure is advised:

"Setting is done either entirely by hand or by a combination of plow and hand. Though the former method usually gives better results, the latter saves both time and labor. When setting by hand, holes should be dug in the bed with a mattock, hoe, etc. Dig the holes as deep as possible without striking the fertilized area, or the subsoil in case no fertilizer was applied. Set the vines, treated end down, as nearly upright as possible and firm the soil around them from bottom to top. The cuttings should be covered to within a short distance of the top node. In cases where the length of the cuttings prohibits such procedure, cover as much of the stem as possible.

When using the plow-hand method, open the beds either with a turning plow or long shovel. Two furrows per row will usually be needed in order to open a trench of sufficient depth. Stand the cuttings upright in the furrow and pack the soil firmly around the base with the hand or feet. Then, using the turning plow, throw soil as high as possible around the cuttings without covering the top node. The bed should not be opened too far in advance of setting as the loss of moisture will hinder the rooting of the cuttings."

A variety of methods of spacing kudzu plants in the field have been used and each method has its own merits. No one specific procedure serves all purposes. Spacing should be determined by the individual in accordance with the specific factors involved.

If an ample supply of planting stock is available and rapid coverage of the land is desired, close spacing should be used. Planting 1,000 plants per acre gives relatively close spacing and with proper fertilization and clean cultivation will usually give a full stand in one year. Using 42-inch rows and setting plants six feet apart in the row on every other row requires approximately 1,000 plants per acre. The alternate rows may be planted to corn or some other row crop the first year.

If there is no hurry to establish the stand or if it is desirable to obtain a stand at less cost the number of plants per acre can be reduced to 500 by setting plants six feet apart on every fourth row; and again the remaining rows may be planted to a row crop that will be clean cultivated during the first two years. With this method, provided the plants grow vigorously, a full stand may be expected by the end of the second year. It is not necessary to plant an intertilled crop with kudzu but it is usually advisable since the land must be cultivated to keep it from becoming foul, and by using an intertilled crop some return may be gotten from the land while the kudzu is becoming established. A one-year old stand of kudzu interplanted with corn is shown in figure 1.

On terraced land, especially on steep slopes, kudzu may be established by planting along the terrace ridges. It should be fertilized and cultivated the first year to enable the plants to become well established. Cultivation of the land between terraces may be continued until the kudzu has spread over these areas; or the kudzu may be kept confined to the terrace by continuous clean cultivation of the intervals between.

Methods of spacing need not be confined to those described above. Any plan may be devised to fit into the conditions of a particular situation. Spacing in the row may be reduced to 3 or 4 feet or increased to more than six feet and spacing between rows planted to kudzu may be varied according to the individual situation.

Preparation of the soil, planting and spacing for the control of erosion on gullied land, on banks and fills, and in diversion ditches is a somewhat different problem from that of an open field. Each case presents its own specific problems. Thorough preparation of the soil, fertilization, and care in planting are just as essential as for field plantings. These practices will be discussed later under use of kudzu for erosion control.

Fertilization of Kudzu

When plantings of kudzu are made on eroded land and soils of low fertility, fertilization is essential to the successful establishment of a stand. It is advisable to use commercial fertilizer and manure on most soils for the initial establishment of a stand to insure vigorous growth of the plants and especially to hasten the development of a good root system. Failures may easily result from plantings on infertile eroded soils unless sufficient plant food is supplied to insure the establishment of the plants.

For field plantings on thin soils where the land is bedded into rows, the fertilizer and manure should be applied in a furrow and the rows bedded on it. When manure is available apply 1 to 3 tons per acre, and 200 to 400 pounds of superphosphate per acre or its equivalent in some other form of available phosphatic fertilizer. If manure is not available use 300 to 600 pounds per acre of an 0-14-7 fertilizer with sufficient nitrogenous fertilizer added to supply about 20 to 30 pounds of nitrogen per acre. On more fertile soils the nitrogen may be omitted, but it is good insurance to hasten establishment of plants.

The fertilizer and manure should be applied in a deep furrow and the rows bedded on it at least one month and preferably a longer time before planting, to allow the fertilizer to dissolve and the manure to decompose. Severe injury or death of plants will likely result from placing plant roots in contact with unrotted manure or a concentration of fertilizer.

If individual holes are to be used for planting around gullies or on banks or fills, dig the hole to a depth of 12 to 15 inches, mix a small amount of manure and 1 or 2 pounds of fertilizer with the soil in the lower part of the hole, then refill the hole. This should be done far enough in advance to allow the manure to rot and the soil to be settled by rain before the plants are set.

When established stands of kudzu fail to make good growth it is advisable to apply a broadcast application of fertilizer, particularly phosphate. Fertilizer investigations with kudzu in various southeastern states have generally shown more pronounced response to phosphate than to potash or lime.

A series of experiments were conducted on five depleted soils in Alabama by Richardson (6) of the Soil Conservation Service to determine the effect of phosphate from different sources, and of potash and lime on the yield of kudzu. A comparison of basic slag, superphosphate and triple superphosphate showed that these materials did not differ in their effects on yields when applied on an equivalent phosphoric acid content basis.

In a summary table of the several experiments (table 1) Richardson shows the effects of phosphate applied at two rates, potash and lime, alone and in combination, on the yields of kudzu. A single broadcast application was made on established stands and yields were obtained over a period of two to four years following the applications. The use of potash or lime alone gave little or no increase in yield, but when used together a marked increase resulted.

The applications of 64 pounds of phosphoric acid alone resulted in a very pronounced increase in yield, with further increases when it was used in combination with potash or lime or both. The 128-pound application of phosphoric acid alone produced a significantly higher yield than the lower rate of application, but little additional increase resulted from applications of potash and lime in conjunction with it.

Further evidence of the value of fertilizing kudzu may be seen from the follow-

Table 1. Effect of phosphate, lime, and potash on the greenweight yield of kudzu.
Mean Kudzu yields according to treatments, pounds per acre of greenweight.

Lime and potash[1]	Per acre rate of P_2O_5		
	None	64 lbs.[2]	128 lbs.[2]
None	6,114	10,212	12,175
Lime	6,033	11,292	12,156
Potash	6,191	11,686	12,371
Lime and potash	7,925	12,038	12,543

[1] Lime application was one ton of dolomitic limestone per acre and potash was 100 pounds of 50 percent muriate of potash per acre.

[2] Exact weight of material determined by material used; 64 pounds P_2O_5, for example from 400 pounds 16 percent superphosphate or from 320 pounds 20 percent superphosphate.

Reference: Journal of American Society of Agronomy, Volume 37: page 766. Experiment conducted by E. C. Richardson, Project Supervisor, Soil Conservation Service, in cooperation with Alabama Agricultural Experiment Station.

ing statements made by Bailey (2) in U.S.D.A. Farmers' Bulletin 1840:

"Fertilizer field trials conducted in 1938 on 41 plantings of kudzu on heavy clay valley soils and gravelly hill soils in the Anniston, Alabama, demonstration area of the Soil Conservation Service included comparable strips which received applications of basic slag at the rates of 800 and 1,600 pounds per acre and one strip on which 600 pounds of basic slag and 150 pounds of nitrate of soda per acre were applied. The fertilizer was broadcast in the early spring. In some cases the land was thoroughly disked after the fertilizer was applied, and on other areas the surface of the soil was not disturbed."

"The results of the fertilizer treatments showed conclusively that kudzu responded to phosphate on all soils included in the trials. In every case there was a marked increase in growth where phosphate was applied, and the heavier applications produced greater growth than did the lighter ones. Growth of plants treated with nitrate of soda and basic slag was not so good as that of plants treated with basic slag only. Weeds and grass grew vigorously in the spring on the strip where nitrate of soda was applied. It was thought that competition from these plants retarded the growth of kudzu. In most of these trials where kudzu was planted in the spring of 1936, the fertilized strips in 1938 made enough growth to provide a fair cutting of hay, whereas the unfertilized strips made barely enough growth to cover the ground. Disking after the fertilizer was applied destroyed weeds and grass and appeared to stimulate the growth of kudzu."

"Applications of phosphate and manure on various soils in the Southeast in 1937 and 1938 gave results which showed conclusively that both of these materials stimulate the growth of kudzu on severely eroded areas and lessen the time required for establishing a stand. Comparative results from fertilized and unfertilized kudzu on severely eroded areas on many farms under cooperative agreement with the Soil Conservation Service demonstrate that the use of phosphate is necessary and also that stable manure is an important factor in establishing a stand."

Cultivation

The clean cultivation of new plantings of kudzu is just as important as any other aspect of stand establishment. The following discussion from Farmers' Bulletin 1840 by Bailey (2) outlines the practices that should be followed and explains why cultivation of new plantings is necessary.

"Clean cultivation during the first and, sometimes, the second growing season is one of the most important requirements for the establishment of a stand. The

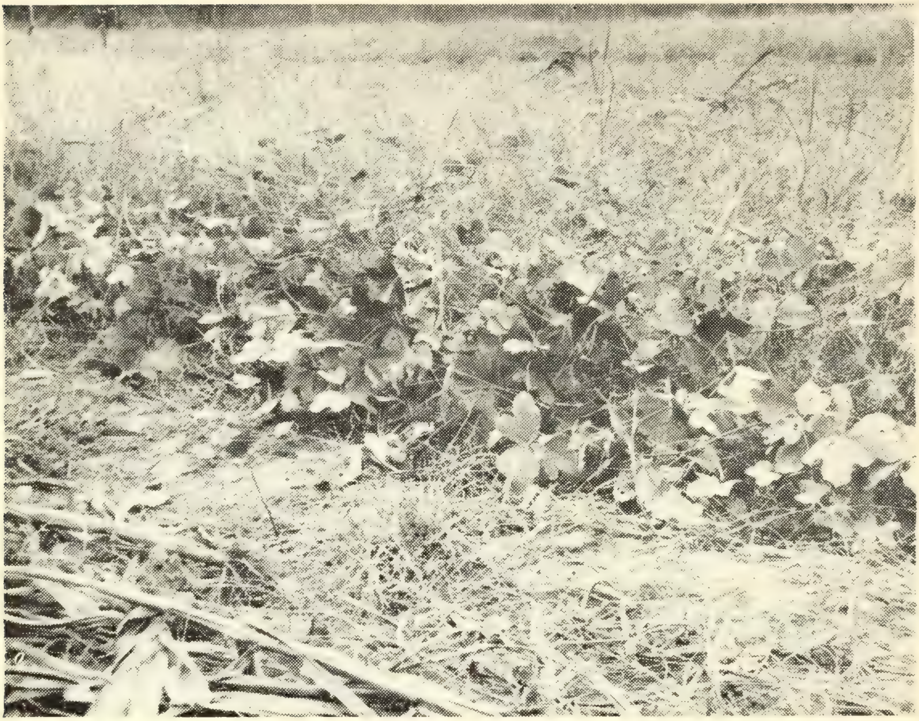

Figure 1. One-year old kudzu plants that were interplanted with corn. Stalks shown in the foreground were pulled down to make the picture.

root system of a kudzu plant is drastically reduced when the plant is dug. As a result of this reduction, competition for moisture by other types of vegetation growing along the rows seriously retards the growth of kudzu during the first spring and summer, unless clean cultivation is given. It is essential that plants be given clean cultivation along the rows during the entire growing season the first year. If necessary, weeds and grass should be hoed out of the rows. Sufficient plowing along the rows to control other vegetation, to keep the soil well broken, and to keep the vines dragged back to a relatively narrow strip along each row is necessary."

"Such a system of cultivation prevents competition by weeds and grass and also results in the development of a thick stand of plants along the rows. Cultivation keeps the surface of the soil in good condition for vines to take root at the nodes. Soil thrown on runners by the plow also induces root formation at the nodes, thus further increasing the number of new plants formed."

"It is important that the middles between the rows of kudzu be plowed in the spring and planted to clean-cultivated row crops. Cotton or corn is more desirable for this purpose than legumes such as cowpeas, soybeans, or velvetbeans. The cultivation necessary for the row crops will control weeds in the middles and keep the soil in good condition for the establishment of new kudzu plants during the latter half of the growing season, after cultivation with the plow has been completed.

"This system of cultivation has the advantage that a crop return may be obtained from the land during the period required for the establishment of kudzu. Such use of the land is important, particularly on farms with limited acreage for the production of feed crops. The greater part of the cultivation necessary for kudzu is thus obtained as a by-product in the production of other crops.

"On fairly fertile soils, where kudzu makes rapid growth, the plants will usually produce runners that take root and establish new plants between the rows after plowing is discontinued the first summer. Where this results in a fair stand of plants over the entire surface of the soil between the rows, it is probably not advisable to cultivate the second year. If, on the other hand, the land is very poor and the first-year growth of kudzu is not sufficient to establish a fair stand of plants in the middles during the latter half of the summer, it is advisable to plant clean-tilled row crops in the middles the second year. It is very important that a strong vigorous stand of plants be established along the original row before cultivation of row crops in the middles is discontinued."

"Frequently a few scattered plants are established in the middles during the latter half of the first growing season and cultivation is discontinued the second season because of the possibility of destroying these plants. Under such conditions, it is usually advisable to plow the middles and plant at least two rows of a clean tilled crop in each the second year, even though a few plants are destroyed.

"By giving enough cultivation to control weeds and to keep the surface of the soil in good condition, a much larger number of plants will be formed and a thicker stand will be established than if cultivation is discontinued before a vigorous stand is established along the original row. If grass and weeds are allowed to grow in the middles the second year, they will support the runners and prevent their coming in contact with the soil sufficiently to give a thick stand of new plants. It is extremely important that a thick stand of plants be obtained because a thick stand produces more effective ground cover and larger yields of hay. No other operation in connection with the establishment of a stand of kudzu is more important than clean first-year cultivation, and second-year cultivation where needed."

Disking established stands of kudzu has proven to be a beneficial practice. This serves several purposes. On newly established stands (2 or 3-years old) cutting the vines with a disk results in a thicker stand and a higher proportion of leaves. Weeds and grasses are destroyed. When the stands are first established it is advisable to make broadcast applications of fertilizer and the disking will serve to work it into the soil. The entire area should be disked including the original rows where the kudzu was planted. Light disking is all that is necessary to cut the vines and work them into some loose soil. Deep disking that turns the soil and cuts the roots loose at a depth of several inches may be injurious and should be avoided.

USES OF KUDZU

Kudzu may be used to serve many purposes on the farm. For controlling badly eroded and gullied areas it is one of the best plants that can be used. Fields that have been depleted of fertility by continuous cropping may be greatly improved by planting to kudzu for a period of years allowing the growth produced to go back to the land and thereby greatly improving the organic content of the soil. When it is properly managed kudzu is excellent for supplementary pasture or as a legume hay crop. On many farms in Mississippi kudzu can be used to good advantage for one or more of these purposes.

Kudzu For Pasture

On a number of Mississippi farms kudzu is now being used for pasture, prim-

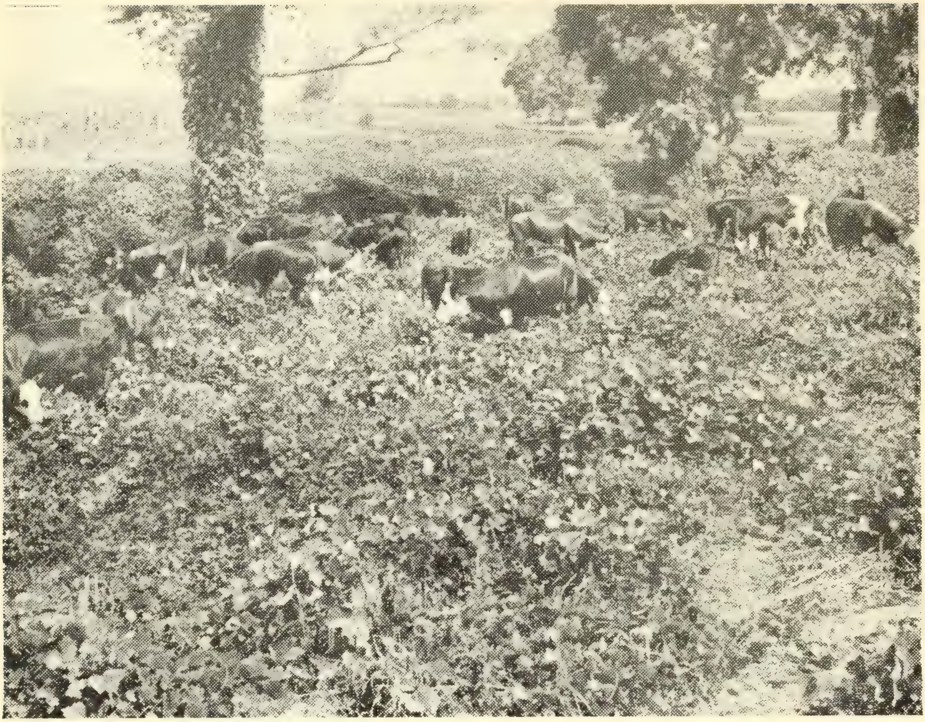

Figure 2. Beef cattle grazing kudzu at the Natchez Branch Experiment Station. This stand of kudzu is five years old. It is on land that was poorly suited to cultivation.

arily for supplementary grazing during the summer months. It is very palatable and is relished by many types of livestock. It has been used for beef cattle, dairy cows, hogs, and chickens. Its use as a pasture crop for livestock is by no means new. As early as 1917 the Alabama Experiment Station used it for grazing dairy cattle to determine its palatability and its effect on the flavor of the milk. Investigations in recent years have shown it to be of great value as a supplementary grazing crop when permanent pastures are in low production.

Kudzu For Beef Cattle

The value of kudzu for temporary pasture for beef cattle has been under investigation at the Natchez Branch Station since 1940. This work has been carried out by H. W. Bennett, S. P. Crockett, and R. W. Williams of the Mississippi Experiment Station staff. A 7-acre field too eroded for profitable use for row crops, was planted to kudzu in March 1940, at the rate of 500 crowns per acre. Corn was grown between the kudzu rows during the first two years. By the third year (1942) the kudzu had made such a growth that it was allowed to cover the entire area. Just before frost, the latter part of October, 1942, the kudzu was mowed for hay and produced a yield of 1.5 tons per acre. In January of 1943 the entire area was disked three times. The disking resulted in a thicker stand with a higher proportion of leaves, and destroyed many weeds present in the stand. Figure 2 shows cattle grazing on this field after the kudzu was well established.

In 1943 the 7-acre field of kudzu was

Table 2. Average weights and liveweight gains of steers grazing kudzu at the Natchez Branch Experiment Station in 1945.

Number, age, and type of animals	Average initial weight	Average final weight	Gain per animal	Gain per day per animal
5 Grade Hereford—2 year old	645	745	100	1.66
5 Native—2 year old	515	655	140	2.33
5 Native—1 year old	370	435	65	1.08

Reference: Mississippi Farm Research, August, 1946. Kudzu for Temporary Pastures; H. W. Bennett, S. P. Crockett, and R. W. Williams.

used for temporary pasture for beef cattle. On June 4 a group of 23 cows and 7 calves were put on the field and grazed for a 28-day period. During this time the animals made a total gain of 540 pounds, equivalent to 77 pounds per acre or 2.75 pounds of beef per acre per day. After this heavy rate of grazing—over four animals per acre—the field was stocked with six yearling heifers which were put on July 7 and grazed until August 27, a period of 51 days. At the end of this grazing period the animals had made a total gain of 450 pounds or 75 pounds per animal. This amounts to 64.3 pounds gain per acre or an average daily gain of 1.26 pounds per acre. Combining the two grazing periods the 7-acre field of kudzu produced a total gain in liveweight of the animals of 990 pounds during the 79-day grazing period, or 141 pounds per acre. And this was produced at a time when the permanent pasture was producing very little and would have been seriously over-grazed had there been no supplementary pasture available.

During 1944 the kudzu was not used for grazing but a crop of hay was harvested which produced an average of 2.3 tons per acre. Grazing tests were continued in 1945 and 1946.

In 1945 grade Hereford and native steers (yearlings and 2-year olds) were used and 15 steers were grazed on the 7-acre field for a period of 60 days during July and August. The rate of stocking the pasture was approximately two animals per acre or 1.09 animal units per acre. The results are summarized in table 2. The 60 days grazing produced a total gain of 1,525 pounds, an average of 218 pounds per acre, or an average daily gain of 3.63 pounds per acre. The native 2-year old steers made much more total gain than the grade Herefords and more than twice as much as the native yearlings.

To obtain further information in 1946 on the value of the kudzu for various types of animals, a group of 10 mature native cows without calves were grazed from August 1 to September 25, a period of 56 days. The cows ranged in weight from 550 to 940 pounds, with an average weight of 703 pounds, which made the rate of stocking one animal unit per acre. The average weight of the cows showed no appreciable gain at the end of the first 28-day period, but all animals gained rapidly during the second 28 days. At the end of the grazing period the group had made a total gain in liveweight of 1,135 pounds or an average of 113.5 pounds per animal. With these animals the kudzu produced 162 pounds liveweight per acre or an average daily gain of 2.9 pounds per acre.

The results at the Natchez Branch Station show that kudzu, even on land unsuited to cultivation, furnishes excellent temporary pasture for various types of beef cattle and that it can be rather heavily grazed during the summer for a period of at least 60 days. If grazing is to be continued for a period of two months or longer the rate of stocking should not be heavier than the equivalent of one animal unit per acre. A longer grazing period may be used by stocking at a lower rate. When stocked so that all of the growth made is not consumed, grazing may be continued until killing frost. And, after growth has been stopped by frost, the surplus remaining may then be grazed if additional grazing is needed at that time. Particular caution should be exercised while kudzu is being pastured to prevent over-grazing, for such a practice will damage the stand and lessen its value the following year. Too heavy grazing or too frequent mowing prevents the plants from storing an ample reserve of carbohydrates in the roots from which to start growth the following spring.

Kudzu For Dairy Cattle

That kudzu is also excellent pasturage for dairy cattle has been shown by investigations carried out by the Alabama Experiment Station (1). Following is a report of an experiment conducted in 1934.

"During the summer of 1934, a study was inaugurated by the Dairy Department at Auburn to observe the relative merits of kudzu versus native grass pasture for dairy cows. Two cows were grazed on a luxuriant growth of kudzu and were alternated with two cows on native grass pasture at 28-day intervals. Both lots of cows were fed grain at the rate of one pound daily to each 2.5 pounds of milk produced. The observations covered three 28-day periods, June 11 to September 2, 1934, after which the test was discontinued because of severe drought. During the 84 days the two cows on kudzu pasture produced a total of 426 pounds more milk and 22 pounds more butterfat than the two cows on native grass pasture. The two cows on kudzu gained in body weight a total of 108 pounds and the two cows on grass pasture lost a total of 52 pounds."

A second experiment carried out in 1938 was made to compare milk production of cows grazing on kudzu with no supplementary feed to cows on native grass pasture with the same grain supplement as used in 1934. There were three cows in each lot and the duration of the test was 140 days. The cows on grass pasture with grain supplement (10.9 pounds grain per cow per day) gave only a slightly higher daily production. The daily increase per cow was .91 pounds of milk and .06 pounds of butterfat. These results indicate that cows will produce well on kudzu pasture without supplementary feed if the pasture is stocked at the rate of not more than one cow per acre.

Kudzu For Hogs

The value of kudzu pasture for hogs was studied by the Alabama Experiment Station (1) over a 3-year period, from 1937 to 1939. Various sizes and ages of hogs were used, from a sow with suckling pigs to medium sized shoats. It was found that it was necessary to supplement the pasture with grain feeding if satisfactory gains were to be made. Results of the test with shoats in 1939 are summarized in table 3. These results show that kudzu alone is little better than carrying pasture for the shoats. The following recommendations are made on the basis of the results of the experiments.

"Suckling sows grazing kudzu should be fed from 2 to 2.5 pounds of grain supplement per head daily for each 100 pounds liveweight. Pigs weighing from 25 to 75 pounds should receive 1 pound of grain supplement daily per 100 pounds liveweight. One acre of good kudzu will carry from 4 to 6 head of mature hogs. Hogs like the fleshly roots of the kudzu plant and are bad about rooting it up. Rings should be placed in the noses of hogs before they are turned on kudzu pasture. Even this may not prove completely effective if the kudzu is growing on sandy soil."

Kudzu For Laying Hens

Investigations conducted by the Poultry Department of the Alabama Experiment Station (1) have shown that kudzu is an excellent grazing crop for laying hens. In tests carried over a period of five years the kudzu was grazed from

Table 3. Results of grazing hogs on kudzu with and without grain supplement, May 31 to September 28, 1939.

Lot[1]	Corn and tankage fed	Average in pounds		
		Initial weight	Final weight	Gain
1	None	88	99	11
2	7 pounds	101	135	34
3	10.5 pounds	104	143	39

[1] Lots 1 and 3 were composed of 5 hogs each, with 1 acre of kudzu for each lot. Lot 2 was composed of 7 hogs on 1.5 acres of kudzu.

Reference: Alabama Experiment Station Circular 83, December, 1939; Kudzu, Its Value and Use in Alabama, page 11.

about May 1 until October 1. Comparable lots of hens given the same base ration were used to compare kudzu grazing to no green feed. The hens grazing kudzu produced an average of 10 eggs per bird per month while those with no green feed produced only 6.2 eggs per bird per month. The following statements were made concerning the use of kudzu for grazing chickens.

"It will furnish grazing from about May 1 until frost. Kudzu will not stand continuous grazing and for best results the chickens should be rotated every 30 to 45 days. One-half acre of well established kudzu divided into two lots is sufficient for 100 hens."

Kudzu For Hay

Kudzu has a number of advantages as a hay crop for Mississippi farms. It is a perennial plant and once established it will continue to produce over a period of years. With proper fertilization it will produce good yields of hay on land that cannot be profitably used for cultivated crops. It does not have a critical stage of growth for cutting as do most hay plants, but may be cut at any convenient time from early summer to late fall. Unlike the annual hay plants in which germination or growth may be seriously affected by weather conditions, particularly droughts, kudzu can be depended upon to make a fair yield of hay every year. Its feeding value is comparable to alfalfa hay.

One or two cuttings may be made during a season. More than two cuttings per season is likely to weaken the plants and deplete the stand. One cutting can be made in June or July whenever its most convenient. When two cuttings are made, the first one should be early in the summer and the second late in the fall just before the normal date of the first killing frost.

Considerable work has been done by the Alabama Experiment Station to determine the proper time and frequency of cutting that would give the highest yield of hay and maintain the stand of kudzu. Results of some of this work are shown in table 4 in which one, two, and three cuttings per season were compared, as well as the time of making the cuttings. This experiment was conducted on an Orangeberg sandy loam soil at Monroeville, Alabama. Soils of this series occur extensively in Southern Mississippi and to a lesser extent in the Central and Northeastern parts of the State. The results in the table show that three cuttings yield no more hay than two cuttings per season; that three cuttings so depleted the stand in six years time that further cutting had to be discontinued; that June 1 and November 1 were the optimum times for cutting in order to maintain a good stand that would be free of weeds. It should be noted that an average of over three tons of hay per acre were produced on this soil.

In good haying weather kudzu cures rapidly and ordinarily can be stored in the barn the day after it is mowed. Cutting should be done when the ground and the kudzu are dry, left in the swath for a few hours, then windrowed. The next morning after the dew is off, the windrows should be turned; and by afternoon the hay may be baled or put in the barn. Some difficulty may be experienced in mowing, particularly fields that are being mowed for the first time, in getting the swath to separate from the uncut vines. A simple shop-made rider bar which is attached to the outer shoe of the mower blade greatly simplifies the mowing problem. This device was originated by the Agricultural Engineering Department at Auburn, Alabama, and is described in Alabama Experiment Station Leaflet No. 16.

To determine the value of kudzu hay for wintering beef cattle of various ages the Animal Husbandry Department of the Mississippi Experiment Station (7) conducted feeding trials in the winter of 1941-42, in which animals fed only kudzu hay were compared to animals fed the standard wintering ration of Dallis grass hay, sorghum silage, and cottonseed meal. Calves, yearling heifers, and mature cows were used in the tests. The calves weighing just over 350 pounds and fed 12 pounds of kudzu hay daily, lost three pounds per head during the first two weeks; while those on standard ration gained 20 pounds per head during the same time. The condition of the calves fed kudzu was considered to be so unsatisfactory that the test was not continued.

Mature Hereford cows in a high state of condition and weighing about 1,200 each were fed 12 pounds of kudzu hay

Figure 3. Dairy cows grazing on kudzu on the experiment station farm, Auburn, Alabama, July 10, 1946.

Table 4. Effect of time and frequency of cutting on yields of kudzu hay at Monroeville, Alabama.

Plot No.	Number of cuttings	Dates of cutting	7-year av. yield per acre 1933-1939	1938		1939	
				Yield per acre	Per-cent weeds	Yield per acre	Per-cent weeds
			Lbs.	Lbs		Lbs.	
1	1	June 1	4,755	5,055	0	3,420	0
2	2	June 1, Aug. 1	6,615	5,865	33	5,970	20
3	3	June 1, Aug. 1 Nov. 1	6,560	5,700	55	0[1]	—
4	3	June 1, Aug. 1 Oct. 1	5,654	4,335	73	0[1]	—
5	2	June 1, Nov. 1	6,416	6,780	5	5,625	3

[1] The stand was so poor that the plot was not cut in 1939. The kudzu was left to re-establish a stand.

Reference: Alabama Experiment Station Circular 83, December 1939; Kudzu, Its Value and Use in Alabama, Page 7.

for a period of 63 days. During this period they lost an average of 65 pounds per head while those fed the standard ration gained 46 pounds each. The loss in weight of the cows fed kudzu was not considered serious because of their original high state of condition.

Yearling heifers were carried in the feeding trials for a 90-day wintering period. Those fed kudzu (slightly over 11 pounds per head daily) approximately maintained their weight; those on standard ration gained 85 pounds per head.

On the basis of these preliminary trials it was stated that where other feeds are not available, or are too expensive, kudzu hay may serve as the principal feed for bringing yearling heifers or bred cows through the winter in a satisfactory condition; especially if as much of this hay is fed as is usually fed of most other hays for wintering cattle of these ages. It was not considered a satisfactory feed for wintering beef calves.

Polk and Gieger (8) of the Mississippi Experiment Station made a study involving the use of kudzu meal to replace alfalfa meal in the starting ration of growing chicks. The results of this work were reported in Experiment Station Bulletin 414 in March, 1945. The experiments showed that there was no significant difference in the final average weights of chicks grown in batteries up to nine weeks of age when fed alfalfa meal, kudzu meal, or kudzu leaf meal at the rate of nine percent of the ration. Under the conditions of the experiment, kudzu products compared favorably to alfalfa meal from the standpoint of average chick weights, mortality, grade, and feed required to produce one pound of gain.

Kudzu For Erosion Control

Erosion is a serious problem on many Mississippi farms and in many cases it has caused abandonment of fields that were once cultivated. The erosion problem is most serious on hill farms in which most of the cultivated land is continuously planted to clean cultivated row crops with little or no precautionary measures being observed to prevent erosion.

Areas that have become gullied to the extent that cultivation is no longer profitable can be satisfactorily brought under control by planting to kudzu, and within a few years time yield additional return as temporary pasture. Kudzu is an ideal plant for a variety of situations where the soil is subjected to erosion. In addition to gullied land and steeply sloping fields, diversion channels, terrace outlets, highway and railway banks and fills when covered with a good stand of kudzu are well protected against erosion.

The value of kudzu for the protection of banks and fills against erosion may be seen in many places along Mississippi

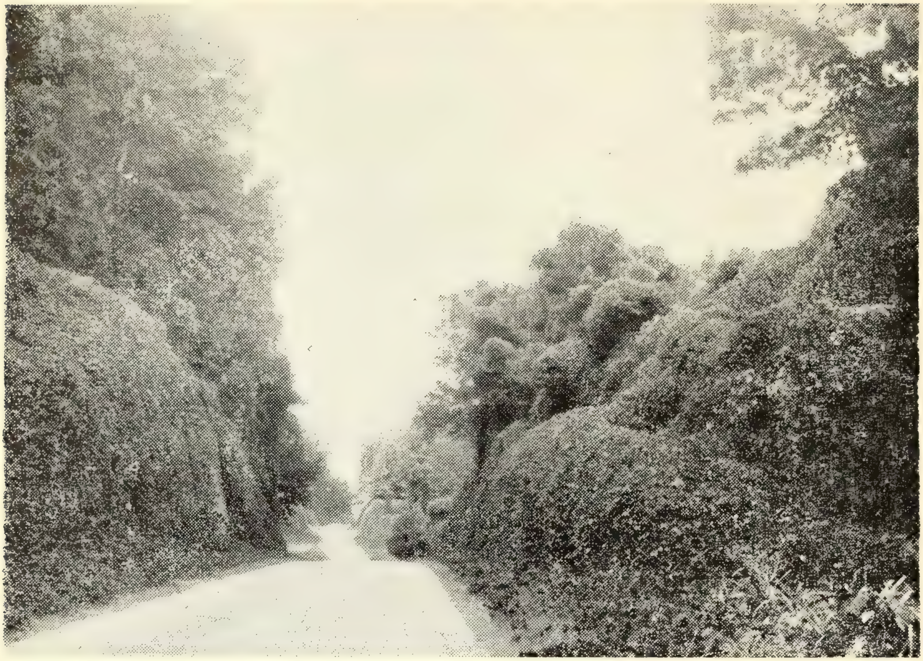

Figure 4. On Highway 60 near Port Gibson, Mississippi, kudzu has completely covered the banks and gives them good protection from erosion. Note how it covers over nearly vertical banks where few other plants could be established.

highways. Figure 4, a view along Highway 60 near Port Gibson, Mississippi shows how kudzu will cover over almost vertical banks. The abundance of leafy vegetation together with the mass of interlaced vines and accumulated organic material protects the soil from direct rainfall and impedes surface run-off as well as increasing infiltration of the water. That gullies can be completely brought under control is shown in figures 5 and 6 showing a gully at the Natchez Station before and after it was planted to kudzu

The effectiveness of kudzu in preventing water run-off and soil loss is shown in table 4, from work done by the Soil Conservation Service at the Southern Piedmont Conservation Experiment Station at Watkinsville, Georgia, on land that was classed as suitable for only occasional or limited cultivation. The average annual rainfall at this location was 50.37 inches. The data show that only a negligible amount of soil was lost under kudzu and that only about one-fourth as much water was lost as under continuous cotton.

In making plantings on gullied areas the plants should be set in and around the gullies in places where there is sufficient soil to insure establishment of the plants. In areas above and between gullies the plants should be set in rows on the contour to facilitate cultivation. In the immediate vicinity of gullies, and in the gullies, it will generally be necessary to set the plants in individually prepared holes. The holes should be made 12 to 18 inches in diameter and 12 to 15 inches deep; mix fertilizer and manure with the soil, refill the hole and allow sufficient time for rains to settle the soil before setting the plants. It is a good practice to set two plants in each hole.

Table 5. Average annual water run-off and soil loss in tons per acre from cotton continuously, serecia lespedeza cut for hay, and kudzu uncut, on 11 percent slope; Watkinsville, Georgia; 1940-45.

	Cotton continuously	Sericea lespedeza	Kudzu
Water run-off, inches	10.70	5.44	2.46
Soil losses, ton per acre	25.27	0.77	0.27

Reference: Mimeograph "Review of Principal Results, 1945," Soil Conservation Service, Southern Piedmont Conservation Experiment Station, Watkinsville, Georgia, May, 1946.

Brush dams built across small gullies causing an accumulation of silt will provide a place to set plants in the gully. In large caving gullies plants may be set in topsoil that has fallen into the gully. Plants should also be spaced along the rim of the gully a few feet from the gully wall. With liberal use of manure and fertilizer, the plants will gradually cover over the gully and prevent further erosion. A gully at the Natchez Branch Station that has been completely covered over by kudzu is shown in figure 6.

Kudzu can be established on banks and fills where it is very difficult or impossible to get a grass-legume sod established. Plants set along the top of a bank will readily spread down over the slope and give it good protection from erosion.

Kudzu For Soil Improvement

Fields that have been continuously cropped to clean cultivated row crops until the soil has reached such a low level of production that it is hardly profitable to continue cultivating can be greatly improved in a few years time by planting to kudzu. The kudzu not only protects the land from erosion, but produces an abundance of vegetation that when plowed under greatly increases the productiveness of the soil. That kudzu is an excellent plant for soil improvement has been shown by work done by the Alabama Experiment Station (1).

In an experiment at Auburn, Alabama, kudzu was planted in the early spring of 1916, allowed to grow for three years then turned under in the spring of 1919. The land was then continuously cropped from 1919 through 1929, during which time two crops of sorghum hay, four crops of corn, and seven crops of oats were grown on the area devoted to the experiment. The average yields of these crops grown following kudzu and where kudzu was not grown (table 5) shows the effect of kudzu on succeeding crops. The increased yields of crops resulting from planting them following kudzu were as follows:

Sorghum hay, 2,536 pounds per acre·
Corn, 19.3 bushels per acre;
Oats, 7.9 bushels per acre.

Even 10 years after the kudzu was plowed under, crops still showed beneficial effects.

A second investigation was conducted between 1930 and 1939 to study the effect of kudzu on the fertility of the soil. Experiments were conducted at two locations in which the kudzu was planted and allowed to remain for four years, after which it was plowed under and five successive crops of corn were grown. Prior to planting the kudzu the land produced 7 to 10 bushels of corn per acre. The 5-year average yield of corn following kudzu was 34 bushels at one location and 30 bushels at the other. These results show the marked effect of kudzu on the fertility of the soil.

The Alabama workers state that with the soil improvement value of kudzu, it would be a good crop in a rotation if a means by which it could be easily established every few years were devised. They suggest the possibility of using it on hilly areas that are terraced. Get kudzu established on the terraces and when it is desirable to establish it on the intervals between terraces, corn could be planted and laid by early thereby giving the vines a

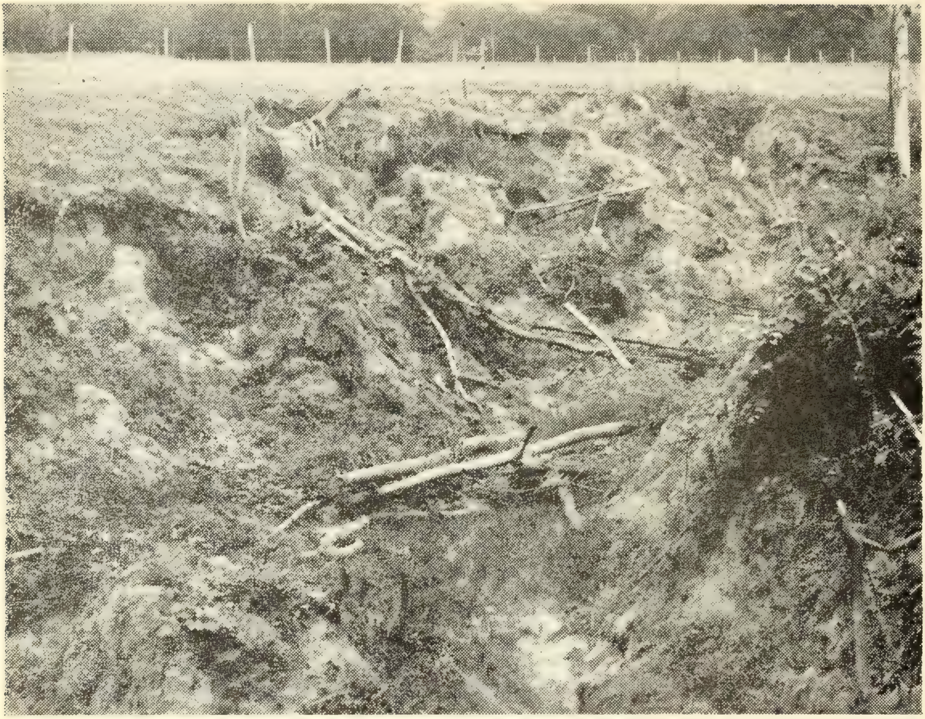

Figure 5. This gully was in the seven-acre field planted to kudzu at the Natchez Station. Photographed in 1939 before the kudzu was planted in 1940.

chance to run across the corn rows and take root. After a few years in kudzu the land could be plowed and again planted to row crops, leaving the kudzu on the terraces. By clean cultivation it could be kept confined to the terraces; and at the same time this growth would always serve to re-establish the field whenever it was desirable. Such a plan of handling kudzu is now under investigation by the Alabama Experiment Station.

Further information on the soil improvement value of kudzu is available from the work done in Alabama by E. C. Richardson of the Soil Conservation Service. Tests were conducted on a number of different soils throughout Alabama to study the effect of stands of kudzu plowed down on the subsequent yields of corn. In most cases kudzu had been on the land for four years or longer. The stands were plowed down and corn was planted in 1940. The first year's results are shown in table 6 together with the yield of corn before kudzu was planted. These data show increases in corn yields ranging from 10 to 36 bushels per acre with an average increase for all tests of 23 bushels per acre. Recovery of the kudzu on the land after the corn was laid by was fair to good in all but one test.

CONTROL OF KUDZU

Since kudzu is a very vigorous growing plant that under favorable conditions will spread rapidly over an area, the idea has developed that it could easily become a pest that would be very difficult to control after it had established itself well. It would offer some difficulty on areas

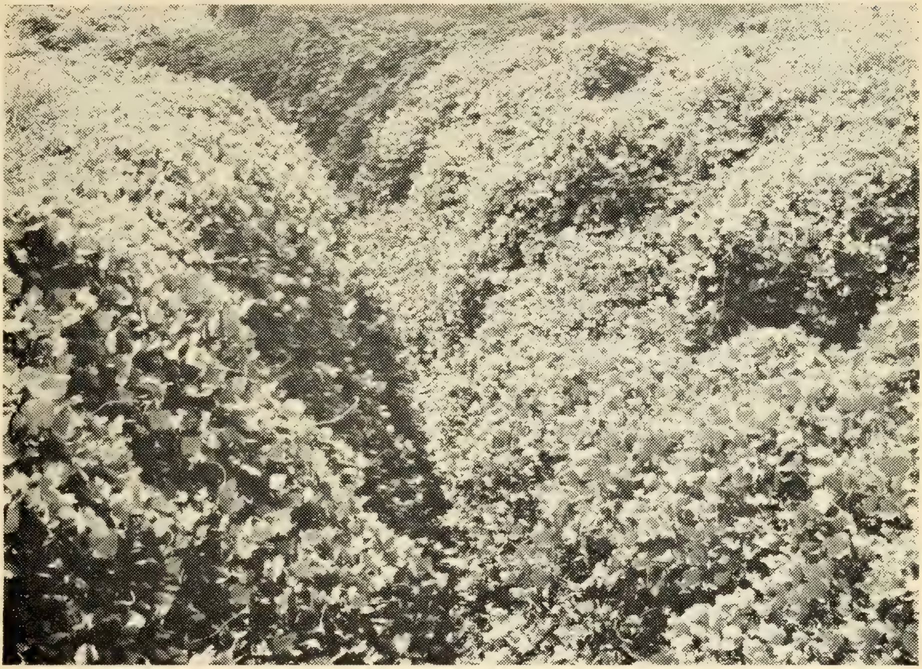

Figure 6. View of the same gully shown in figure 5. The five-year old kudzu has completely healed the gully from erosion and now furnishes excellent grazing for cattle.

that could not be plowed, grazed or mowed. However those experienced in handling it know that under field conditions it is not a difficult problem to eradicate. Generally one or two years of continuous heavy grazing will destroy an established stand of kudzu. On land suitable for cultivation an established stand can be destroyed in one year by plowing and planting a clean cultivated row crop. Frequent mowing weakens a stand the same as heavy gazing, and if practiced will exhaust the roots to the extent that the stand will be destroyed. Numerous reports give evidence that kudzu can be easily controlled or confined to a definite area such as a terrace, by clean cultivation of adjacent areas. This prevents vines from rooting at the nodes and does not allow it to become established.

INSECTS AND DISEASES

While there have been no reports as yet of loss of kudzu stands by insects or diseases, some rather serious injuries have occurred and it may be well to be familiar with some that are known to attack kudzu. As its use becomes more widespread there is greater possibility of encountering some problems with insects and diseases.

The plant is susceptible to nematodes which cause a condition on the roots commonly called root knot. It is a small eel-like worm that is a serious pest on some crops, although it has not been known to kill stands of kudzu. Some trouble has been encountered in Mississippi in establishing stands with nematode-infected crowns. Poor stands are likely to result from planting nematode-infected plants or planting on nematode-infested soil. Plantings should not be made on soils that are known to be infested. It would be wise to observe carefully the roots of

Table 6. Influence of kudzu on the yields of succeeding crops.

Plot	Average yields of following crops		
	2 crops sorghum hay, pounds per acre	4 crops corn, bushels per acre	7 crops oats, bushels per acre
1 No kudzu	3,264	14.7	16.6
2 Kudzu	5,800	34.0	24.5

Reference: Alabama Experiment Station Circular 83, December 1939; Kudzu, Its Value and Use in Alabama; page 12.

Table 7. The effect of kudzu on corn yields at various places in Alabama, 1940.

Test No.	Land use prior to planting kudzu	Date kudzu planted	Corn yield, bushels per acre		Growth of kudzu in corn
			Before kudzu	After kudzu	
1	Cultivated	1936	7	27	good
2	Cultivated	1936	15	39	fair
3	Idle	1935	3	17	good
4	Idle	1935	10	38	good
5	Idle	1935	12	28	good
6	Cultivated	1935	10	22	fair
7	Cultivated	1936	6	33	good
8	Idle	1936	4	20	good
9	Cultivated	1936	12	32	good
10	Cultivated	1932	10	35	good
11	Cultivated	1926	10	41	good
12	Idle	1930	5	28	poor
13	Cultivated	1936	8	44	good
14	Idle	1936	5	35	good
15	Idle	1936	8	32	fair
16	Idle	1936	5	30	good
17	No information	1936	—	35	good
18	No information	1936	—	29	good
19	Cultivated	1934	5	38	fair
20	Cultivated	——	5	15	——
21	Cultivated	1936	4	21	good
22	Cultivated	1936	4	30	good
		Average	7	30	——

Reference: Data supplied by E. C. Richardson of the Soil Conservation Service and the Alabama Agricultural Experiment Station, Auburn, Alabama.

purchased plants to make sure that they are not infected with nematodes.

Grasshoppers sometimes attack kudzu but they are not likely to cause serious damage. Heavy infestations may give the leaves a very ragged appearance but unless the attack comes late in the fall, a new crop of foliage will be produced before frost.

The velvetbean caterpillar attacks kudzu as well as several other leguminous plants. Serious infestations on kudzu occurred in the fall of 1943 in southern Mississippi according to a report made by Clay Lyle (9). Fields of kudzu may be stripped of their leaves when heavy infestations occur. The caterpillar is a tropical or subtropical insect which moves northward through Florida and Texas each year, usually reaching Mississippi in late summer or early fall. When full-grown the caterpillar is about 1.5 inches long, greenish or blackish in color and has several narrow, light stripes extending full length along its back and sides. Its general appearance is similar to the leafworm or "armyworm" on cotton. The safest and most economical control is dusting with cryolite at 7 to 12 pounds per acre. The material does not burn the plants and it is not dangerous for livestock on pastures or hay.

Bacterial halo blight of kudzu has been observed on some stands of kudzu in Mississippi. In 1946 infections were observed on stands in the Holly Springs area and were estimated to cause a loss of 10 to 15 percent of the hay crop. This disease was first described by Hedges (10) in Georgia in 1928. It occurs on the leaves, leaf petioles, and vines of the plant. The early symptoms of the disease are very small spots bordered by a pale yellowish halo one-fourth to one inch in diameter. Several spots on a leaflet may cause the entire leaflet to become chlorotic (pale yellowish color) and more or less drawn and deformed. In the latter stages of a heavy infection the leaves die and drop from the plant. Damp and rainy weather creates ideal conditions for development of the disease. It may be spread on seed or on vegetative parts of the plant such as on crowns or in hay. Investigations are now underway by the Mississippi Experiment Station to find a strain of kudzu resistant to the disease.

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BULLETIN 439 NOVEMBER 1946

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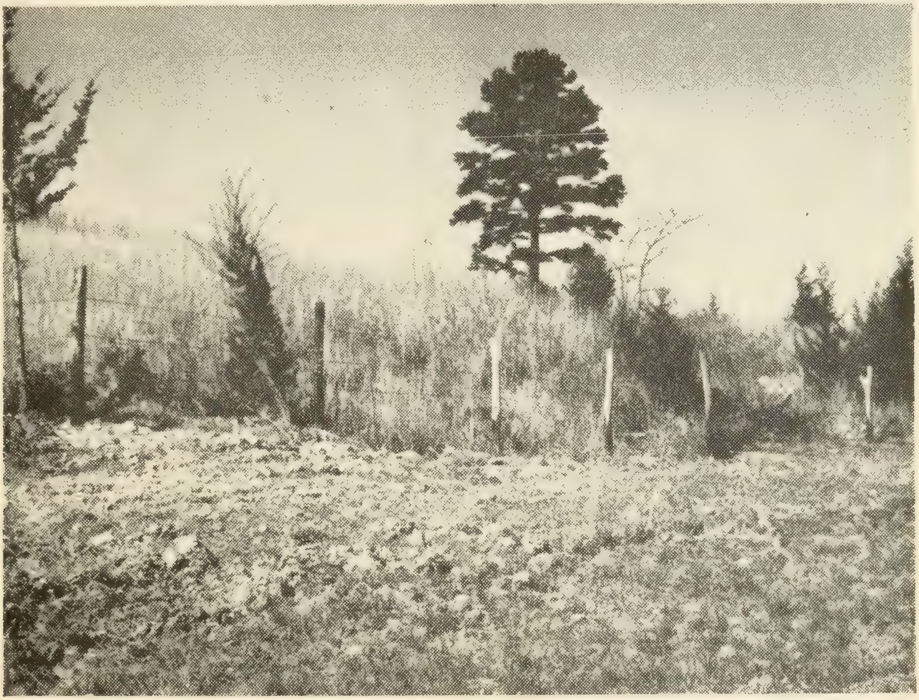
FENCE POSTS: PRODUCTION AND TREATING COSTS



Good fencing is necessary on modern farms. The one above was constructed with fence posts treated in the fence post preservative treatment research program at State College.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

Fence post supplies in Mississippi are entirely inadequate to meet a demand, estimated to be 6,000,000 posts per year for the next two decades. If we are to avoid excessively high costs of post replacement resulting from the use of non-durable posts, some preservative treatment is a necessity.

Any such treatment must be simple but effective. In any case it must be inexpensive. Results of the work at Mississippi State College in 1946 indicate that there are two methods and two preservatives which meet these specifications.

Zinc Chloride, applied by the steeping method will give a post at a cost of 2 6/10 cents per year.

Pentachlorophenol, applied by a cold soaking method will give a post costing not over 2 2/10 cents per year.

Farmers may economically use either of these methods which require no special equipment.

There seems to be some possibility of the development of small community treating plants to serve areas as large as a county. More investigations on this phase of post treatment are necessary.

Caution. All preservatives are more or less poisonous. Cattle should be excluded from the vicinity of the farm treating plant and reasonable care must be exercised by persons using wood preservatives.

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FENCE POSTS: PRODUCTION AND TREATING COSTS

By W. C. HOPKINS

Farmers and other users of fence posts, located in regions or states devoid of naturally durable tree species, have always been without a simple, but satisfactory method of treating these fence posts. This has come about, not because of lack of research work on the problems, but simply because the known, effective preservatives have not been of a nature which lends itself to simple treating methods. Within the past ten years new preservatives and new processes have been developed, some of which seem to give promise of simple, economical use by farmers.

In order to be suitable for farmer application a preservative must be relatively easy to use, must require no elaborate or expensive equipment, and must not involve any work which has to be done at the farmer's busy season. These are rigid specifications which heretofore have ruled out almost every preservative and every method of treating.

The famous hot and cold bath method so widely discussed and the chief basis for U.S.D.A. Farmers' Bulletin No. 744,[9] is virtually eliminated from any consideration by these specifications. Other much talked about treatments such as the tire tube method,[13] are not satisfactory if any number of fence posts are to be treated. The application of the preservative although seemingly simple, is time consuming.

Two factors made a study of the various treating methods of great importance to the farmers of Mississippi. First, there is only a very small area of the state which has tree species naturally durable enough to make satisfactory fence posts. Second, it is now apparent that a more diversified type of agriculture, requiring a much greater amount of fencing, will soon be prevalent in the state. This interacts with the scarcity of suitable fence post species to create a necessity for a simple, economical treatment.

Wood is subject to attack by two agencies which cause deterioration. Fungi actually grow on the wood fibers, breaking them down by chemical action and utilizing them for food. Insects too, use wood for food, but the action of destruction is mechanical. Both agencies thrive best in a moist atmosphere, but both also require air, food, and certain temperatures. In the moist warm climate of Mississippi, conditions are favorable to these destructive organisms.

Since we cannot control the conditions of temperature or air, any attempts at preservative treatment must be concerned with poisoning the food supply and reducing the moisture content of the wood. Oil preservatives usually aim at both of these objectives, whereas the water soluble preservatives deal primarily with poisoning.

The species of wood which are by nature resistant to the attacks of insects and fungi possess this characteristic because they contain large amounts of heartwood which has in it natural oils that not only resist penetration by water, but which are also toxic.

FENCE POST REQUIREMENTS AND SUPPLY IN MISSISSIPPI

Normal annual consumption of fence posts in Mississippi is between 3.5 and 4 million posts. The accumulated, war-postponed fencing of the past five years will easily boost requirements for the next three years to 6 million per year. When the factor of diversification of farm enterprise is taken into account, it appears that this requirement of 6 million posts per year will continue for some time, possibly as much as 20 years. A further demand on our supply is being made by out-of-state markets. At present posts of durable species are being shipped in carload quantities to middle-western states which have no fence post supply. Presumably, this demand will continue and possibly will increase as wire and staples become available and war-deferred fencing programs get under way.

Mississippi's resource of natural fence posts is very limited. Five species: Bois D'Arc, black locust, red cedar, red mulberry, and old growth cypress are the only durable woods remaining in any quantity and they are found in numbers only locally.

Bois D'Arc was formerly found widely scattered over the delta and black belt sections as hedge fences, but most of these have been grubbed out until it is now confined almost entirely to the black belt section of the state. Black locust is native to Mississippi only on the Pontotoc Ridge. Although it has been very widely planted over the state, it has been almost a complete failure on the pine soils, consequently only a small supply is available. Red cedar, while scattered throughout the state, is present in quantity only on the lime soils of northeast Mississippi. Red mulberry occurs throughout the state on rich soils but is abundant in no locality. The supply of this species is so small as to be of minor importance in meeting the requirements. Cypress is found in relatively small quantities only in the delta section and in river bottoms.

The region of greatest concentration of these satisfactory fence post species is the very area which should see the greatest diversification of farming. As a result many of the posts produced within the region will be used right there. There will be very few for export to other sections of the state.

The need, over much of Mississippi, for a simple, efficient means of prolonging the life of a fence post is obvious. The native durable woods give service from 15 to 30 years, but few others will last six years. Many posts being placed in service have a life expectancy of not more than two or three years. Fence post replacement involves far more than the cost of the post. The costs of setting and nailing on the fence, in the case of the cheap non-durable posts so widely used, equals or exceeds the cost of the post. Every time a farmer sets a pine post and puts a fence on it, he spends about 20 cents.

These posts will last no more than three years. In fifteen years, therefore he spends one dollar. A pine post given a good treatment with one of the more recently developed preservatives, pentachlorophenol, should last 20 years at a cost of forty-three cents. This cost includes ten cents for placement and fastening the wire. The untreated post, then, costs 6-2/3 cents a year, whereas the treated post costs only 2-1/6 cents a year. Four and one-half cents per post per year amounts to considerable saving, even on a small farm.

Great opportunities for utilization of many of the inferior hardwood species exist in the field of fence post treatment. Experiments at Mississippi State College during 1946 have definitely proven that species such as elm, red gum, water oak, blackjack oak, and post oak, can be treated efficiently. Service records on these posts are not yet available, nor will they be for a long period of time. Ten year service records on pine posts treated with the same preservatives are available, however, and these posts are standing up remarkably well.

It now appears possible to treat almost anything in the woods and make a good post of it. This is a very important consideration because it helps to relieve the demand on the few durable woods we have, conserves pine posts which are more valuable if left to grow to larger size, and helps us develop a system of cutting in our woodlands which will be an aid in controlling the encroachment of hardwoods.

PREPARATION OF POSTS FOR TREATMENT

In all but one of the treatment methods to be discussed in detail in the next section, some pre-treatment preparation of the posts is necessary. The two steps

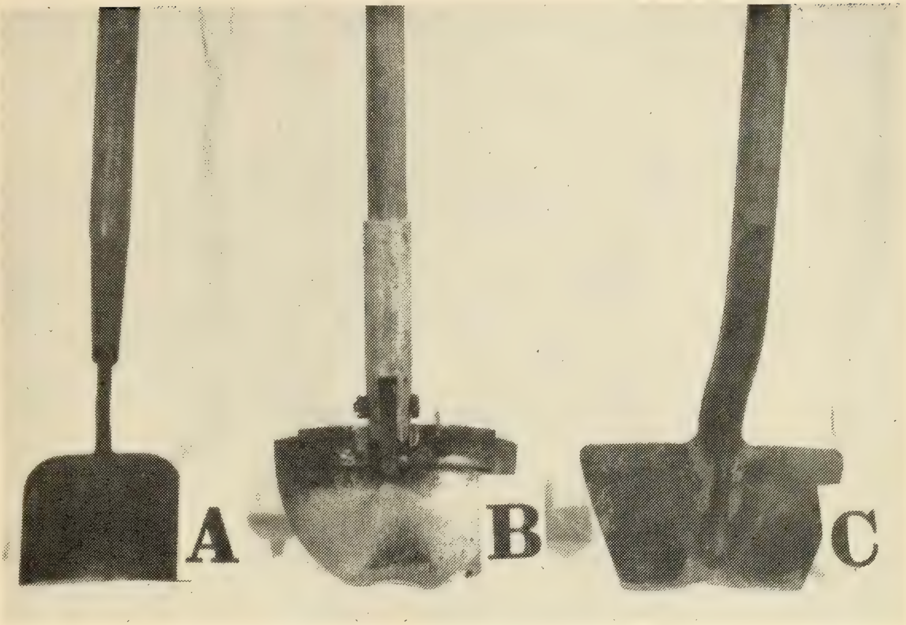

Figure 1. Post peeling tools. a. Hoe, b. Bottom half of shovel, c. Top half of shovel.

of this preparation are peeling and seasoning.

Peeling

Peeling, or removal of all bark from the post, is one of the most expensive operations in connection with fence post treatment. Unfortunately, it is also a very necessary operation. Preservatives, ordinarily, will not penetrate even the thin inner bark of trees, so that all bark, both outer and inner, must be removed from each post to be treated. Many tools have been used to do this job and each has its proponents. Most used in Mississippi, probably, is an old hoe, straightened out and ground down on the cutting edge so that a concave edge is obtained. In use, this tool is pushed along the log or post, removing a narrow strip of bark in the process.

A tool recently developed at the Mississippi Agricultural Experiment Station seems to be somewhat better.[4] This tool was made from the tip of the blade of an old round pointed shovel, ground concave on the cutting edge and fitted with a handle. It too, is used as a push tool, but has an advantage over the hoe in greater weight and more rigid construction. Another tool was constructed from the top half of the shovel blade and it also appears to be more satisfactory than the hoe. These three tools are shown in figure 1.

Peeling is most easily done in the spring and early summer when the sap is flowing more freely in the trees. The bark is loose at this time and is easily removable from most species of trees. However, this is the farmer's busy season and it is not expected that many will be able to fit this phase of post preparation into an already crowded time budget. Delayed peeling seems to have some possibilities. This method involves stacking the posts with the bark on for some time before attempting to remove the bark. Drying coupled with the activities

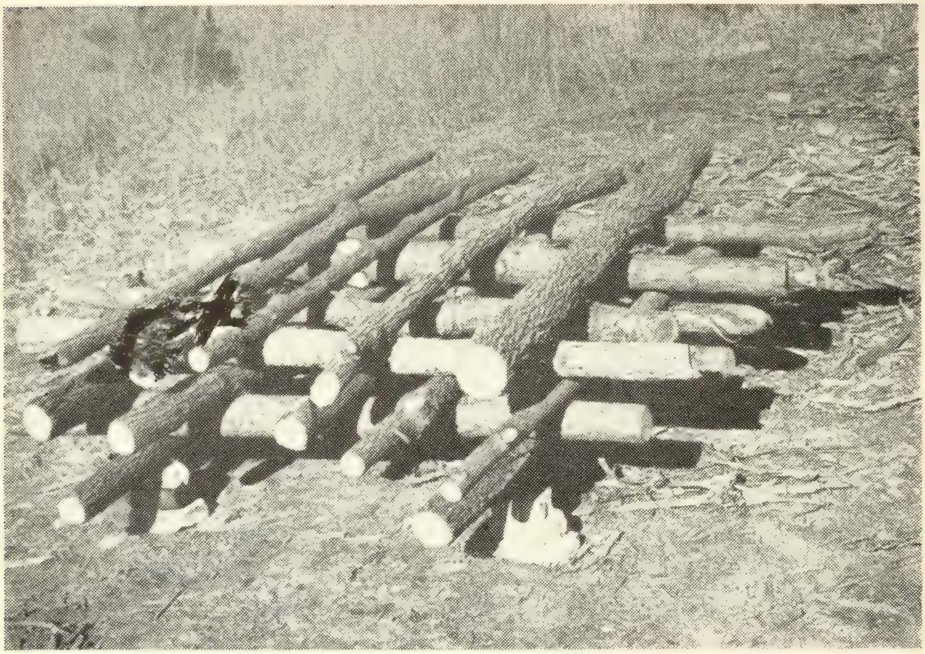

Figure 2. Good piling practice.

of some bark insects loosens the bark so that it comes off with comparatively little effort. Use of this method enables the farmer to cut his posts late in the summer or early in the fall and then remove the bark from seasoned posts a short time prior to treating. Post preparation and treating may then become winter activities which will not seriously hamper other work.

Seasoning

Several of the treating methods to be discussed, including the one which seems most promising, require that the posts be well seasoned or dried prior to application of the treatment. Good seasoning requires that the posts be piled and allowed to dry for 60 to 120 days, depending upon the time of year. Posts seasoned during the summer will dry more rapidly than those seasoned during the winter.

Proper piling is necessary if posts are to be seasoned without incurring attack by decay causing organisms. An open pile, so constructed that air will circulate freely around each post is best. The bottom of the pile should be raised at least a foot from the ground. Such a pile is illustrated in figure 2. Another method of piling, not so desirable, is shown in figure 3.

Posts should never be closely piled, or piled on the ground for seasoning. The large amounts of moisture present in the ground and in the posts create optimum conditions for the incidence of decay organisms. An illustration of very poor seasoning practice is shown in figure 4.

As posts season, cracks and checks develop on the surface. It is important that all checking take place prior to treatment because checks which develop after treatment may expose untreated wood and form an entrance for decay. Checking could be so severe as to detract from the nail-holding characteristics of the post.

If seasoning is to be done during the hot summer months and it is suspected that checking may be severe, the posts may be piled for seasoning in the shade where they will dry less rapidly.

Although there are no data to prove its value, it is recommended, without exception, that the tops of all posts be sharpened to a sharp edge with an axe. This gives the post a sloping roof which sheds water and prevents decay from the top. The smoothest saw cut is not satisfactory because it leaves a fuzzy surface which will retain some water. An axe cut, on the other hand, gives a very smooth surface. The operation should be performed after seasoning in order that no end checks will develop and prior to treating so that the superficial top treatment to be recommended will coat the cut surface.

Posts may be cut at any season of the year if properly cared for. As a rule, on the farm, they will be cut during the fall and winter. In any case, they should be piled to season immediately following cutting.

METHODS OF PRESERVATIVE TREATMENT

Wood preservatives fall into two general categories: (1), the oil or oil soluble preservatives and (2) the water soluble preservatives. Each has its uses and for some purposes the water soluble preservatives are quite satisfactory. It is felt that the oily chemicals will prove far superior for fence post treating in a climatic region which has as high annual rainfall as does Mississippi. It may well be that the service records will prove that we can obtain satisfactory treatments with some of the water soluble salts.

The Mississippi Agricultural Experiment Station began an experiment on preservatives and methods of application early in 1946. At that time it was decided to use two of the oil preservatives,

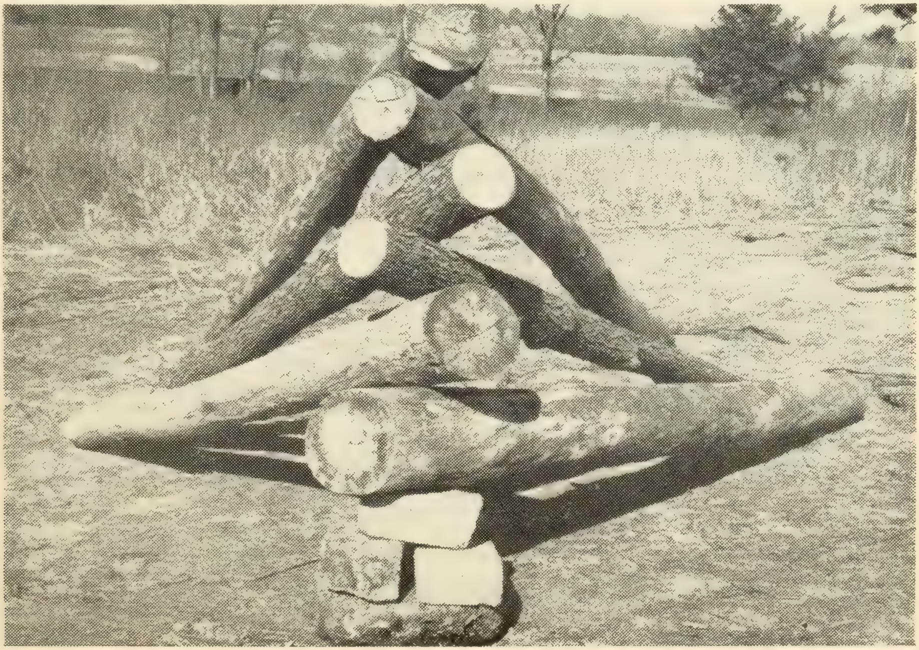

Figure 3. Another method of piling. Not so desirable.

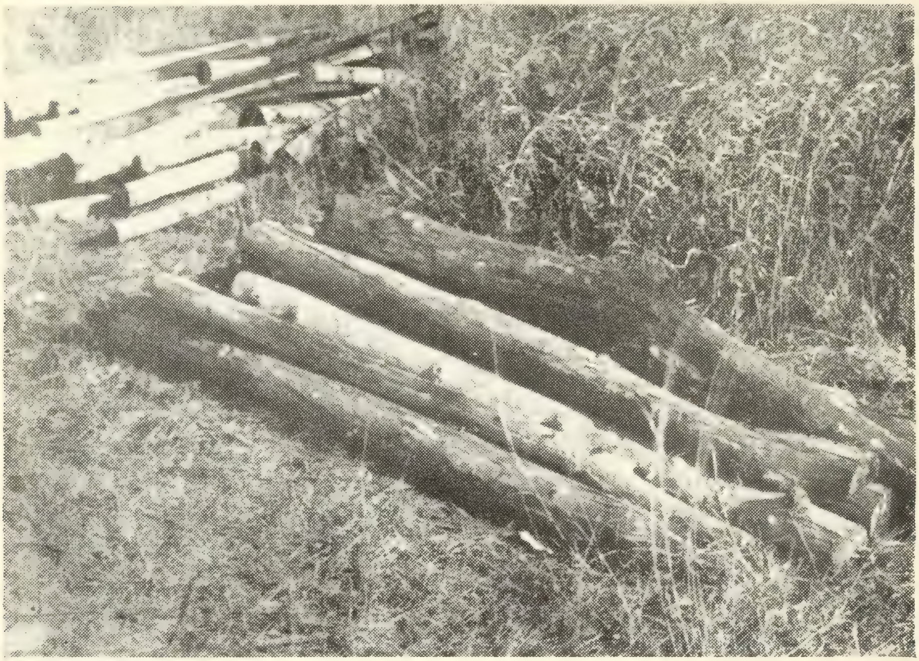

Figure 4. Very poor piling practice.

two of the soluble salts, and one which is a combination of the two. These preservatives were to be applied by different methods to five different species of posts —pine, red gum, red oak, post oak, and elm. Thirty posts of each species were to be treated by each method and each post was to be numbered and placed in service in the Dairy Department fences.

The first phase of the study, that involving the collection of data on costs of cutting, preparing, and treating, is now complete. Certain inferences as to expected service from posts in each treatment may be drawn from service records at other places.

It is felt that a publication embodying complete descriptions of each method of treatment and comparing costs of treatments may be of value at this time. At least one of the methods of treatment to be discussed below has much to recommend it to the farmer who has to treat fence posts.

Oil Preservatives

Hot and Cold Bath, Creosote

For a good many years the standard method of applying oil preservatives on a small scale has been by using a hot and cold bath plant. This involves immersion of the posts in a bath of hot preservative for several hours, removal from the hot bath, and immediate transfer to the cold preservative bath for a period of an hour or so. The principle underlying this method of treatment is the fact that a partial vacuum is created within the hot post when it is plunged into the cold preservative and ordinary atmospheric pressure forces the preservative into the wood.

Creosote, both pure and in mixture with other oils such as used crankcase oil, has been the standard preservative for use with this method. This preservative, in small lots, is expensive and it is not very pleasant to handle or work around, especially when hot.

A considerable investment in a treating plant is necessary, too. The experimental treating plant at State College was built at a cost of $200.00, and it is close to the minimum operable size. A picture of this plant is shown in figure 5.

The plant requires two tanks at least four feet deep. This automatically rules out the 55 gallon oil drums which are most readily available. 100 gallon oil drums would serve, but cannot be found. The tanks in the plant pictured were secured by buying a 500-gallon oil tank and cutting it in half. This gave 2 tanks of 250 gallon capacity. Beneath one tank a furnace must be constructed for the purpose of heating the creosote. The furnace need not be elaborate, but should be almost as large as the diameter of the tank and works best if rough grates are constructed. The flue will be safer if led away from the tank underground for several feet before being turned up. This, too, gives adequate room to work about the tank. The tanks must either be set up on a bank or a ramp must be built up alongside them to facilitate handling the posts.

In figure 5 it will be noted that the two tanks are set down in the ground, the hot tank on the left of the picture being slightly higher than the cold tank on the right. A pole rack leads up to the hot tank, extends between the two tanks, and then leads away from the cold tank. This facilitates handling of the posts between the tanks. If a roof is to be con-

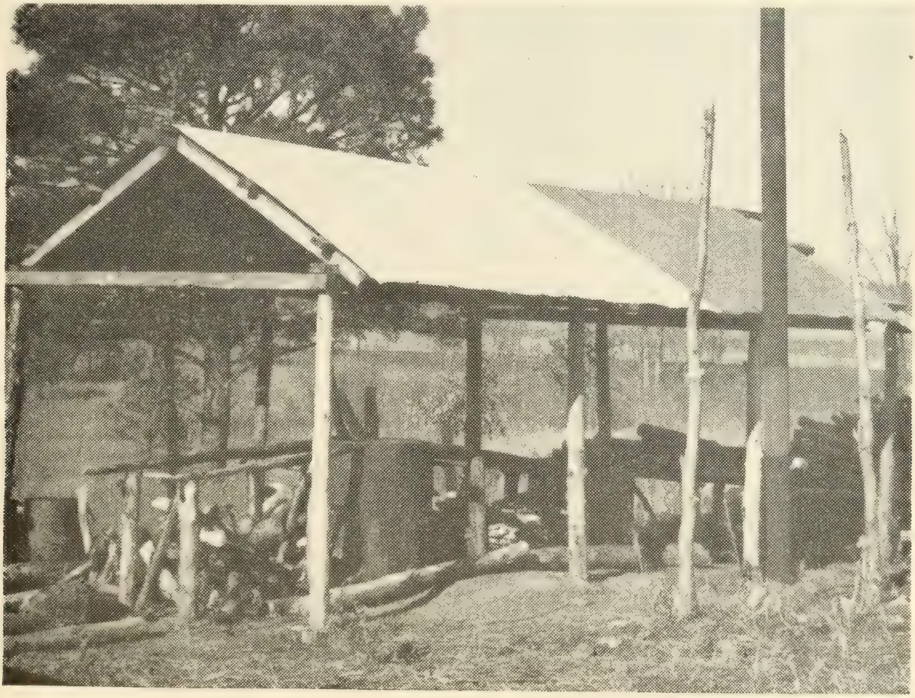

Figure 5. Experimental Post Treating Plant at State College, Miss.

structed over the tanks, it should be, at the lowest point, six feet above the top of the tank.

Older bulletins have advised that a rack with projecting screws or nails should be placed in the bottom of the tanks. Posts, impaled on these nails or screws, would then remain immersed. The work here has proven that posts can be held immersed to half of their length without such a device. Most of them are heavy enough to stay down and the few which persist in rising a few inches can either be wedged between other posts or held down with a brick or small rock laid on top of them.

In operation the plant is simple. A good fire is built beneath the hot tank which has been filled to a depth of two feet with pure creosote or creosote and used crankcase oil in the proportion of 1 to 1. The oil in this tank is heated to a temperature of 220° to 240° Fahrenheit. Meantime, 30 or 40 posts have been placed on the rack leading to the hot tank and the cold tank has been filled with pure creosote to a depth of two feet.

When the temperature reaches 220° Fahrenheit, posts are placed in the tank, butt end down, one at a time until no more can be gotten in or until the level of the oil in the tank rises to within six inches of the top. Care must be taken not to splash the oil over onto the fire. The time is noted so that after two hours have elapsed, the posts may be removed. An ordinary candy thermometer may be used to determine the temperature of the oil. The oil in the cold tank should have a temperature of about 100° Fahrenheit and if treating is being done during the winter, it may be necessary to add some hot oil from the hot tank.

After two hours have elapsed, the posts are removed from the hot tank and transferred at once to the cold tank, where they should remain for a period of time which may vary from 15 minutes to 1 hour. Treating schedules (length of time required in each tank) indicated by the experiments at State College are shown in table 1.

Table 1. Schedules of treating indicated for various species by experiments at Mississippi State College.

Kind of post	Time in hot bath	Time in cold bath
Pine	2 hours	20 minutes
Red Gum	2 hours	30 minutes
Red Oak	2 hours	1 hour
Post Oak	2 hours	1 hour and 15 minutes
Elm	2 hours	2 hours

Actually, all posts were treated on a schedule of 2 hours hot bath and one hour cold bath. The desired objective was an absorption of 6 pounds of creosote per cubic foot of wood, which translated to terms of posts mean an absorption of 3 pounds per post since each post was treated only half length and since each post averaged about one cubic foot in volume. The average absorptions obtained are shown in table 2. Table 1 has been constructed by applying the author's best judgment to the absorptions actually obtained on the 2-1 schedule.

Absorptions were obtained by measuring the depth in inches of the creosote in the cold tank immediately after placing the posts in it and just prior to removing the posts from it. The latter, subtracted from the former gives the number of inches change in depth, and this multiplied by the number of gallons represented by one inch of depth of tank, gives the gallons absorbed. This is easily translated to pounds by weighing one gallon of the preservative. The average absorption was then obtained by dividing the number of pounds absorbed by the number of posts in the charge.

If species of posts other than those listed are to be treated by this method, a few trial batches should be run at different schedules to determine which is best. Ordinarily, six pounds of creosote per cubic foot of wood will give a very satisfactory fence post.

Table 2. Actual average absorptions, in pounds per post, obtained on species used in tests at Mississippi State College. Hot and cold bath creosote.

Kind of Post	Schedule	Average absorption	Remarks
Pine	2-1	8.70	Too high—reduce time cold bath
Red Gum	2-1	6.30	Too high—reduce time cold bath
Red Oak	2-1	2.80	Good
Post Oak	2-1	2.00	Too low—lengthen time cold bath
Elm	2-1	1.67	Too low—double time cold bath

In this, as in all tests at the college, half of the posts were also given a superficial, top treatment which consisted simply of dipping the top half of the post in the cold creosote a sufficiently long time to insure coating it with the preservative. Although data to substantiate the concept of top failure are lacking, it is recommended that such a top treatment be given in all instances. Because the top of the post is not subjected to long periods of dampness as is the bottom, the more effective hot and cold bath treatment does not seem necessary.

DIP METHOD—CREOSOTE

Creosote has been used and is still being used in a simple dipping or brushing process. This may afford sufficient protection for wood not in contact with the ground or not subjected to a great amount of moisture for considerable periods of time. For fence posts, however, it represents a waste of time and money simply because there is no absorption of the oil and the thin outer coat is ineffective in preventing absorption of water and entrance of decay causing organisms.

The method consists of simply dipping the post for an hour or so in warm creosote, or in painting warm creosote on the surface of the post with a brush. Posts held for two hours in a very hot bath of creosote absorbed no appreciable amounts of the preservative.

A comparison of the penetration obtained by the hot and cold bath method as against the dipping method is shown in figure 6.

PENTACHLOROPHENOL

Within the past ten years a new chemical, pentachlorophenol, has come into the wood preservative field. Now coming onto the market in fair quantities, under various trade names, and put out by several chemical companies,[1] it holds great promise of becoming one of the most easily applied and most satisfactory wood preservatives. Although tests thus far are not comprehensive enough and service records are not long enough to prove conclusively the value of this preservative, it is 10 to 100 times as toxic as creosote and much easier to use.

Pentachlorophenol is available in either a dry flake or concentrated solution form. In most cases the concentrated solution will be somewhat easier to use. Soluble in very thin petroleum oils, it has much the same property as water in that it will penetrate wood very rapidly and easily. While it may also be applied by the hot and cold bath method, there are much simpler methods which will give an effective fence post treatment. In the experiments which form the basis of this report it was applied by both the hot and cold bath and the cold soaking methods. The preservatives used in these experiments were contributed by A. D. Chapman and Co., and Wood Treating Chemicals Co.

Hot and Cold Bath

The same plant was used with this preservative but a different technique was

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[1] A. D. Chapman & Co., 333 N. Mich. Ave., Chicago 1, Illinois; The Dow Chemical Co., Dowicide Division, Midland, Michigan; I. F. Lanchs, Inc., 911 Western Ave., Seattle 4, Washington; Monsanto Chemical Co., 1700 S. 2nd St., St. Louis 4, Missouri.; Wood Treating Chemicals Co., 5137 Southwest Ave., St. Louis 10, Missouri; Protection Products Mfg. Co., Box 747, Kalamazoo 99, Michigan.

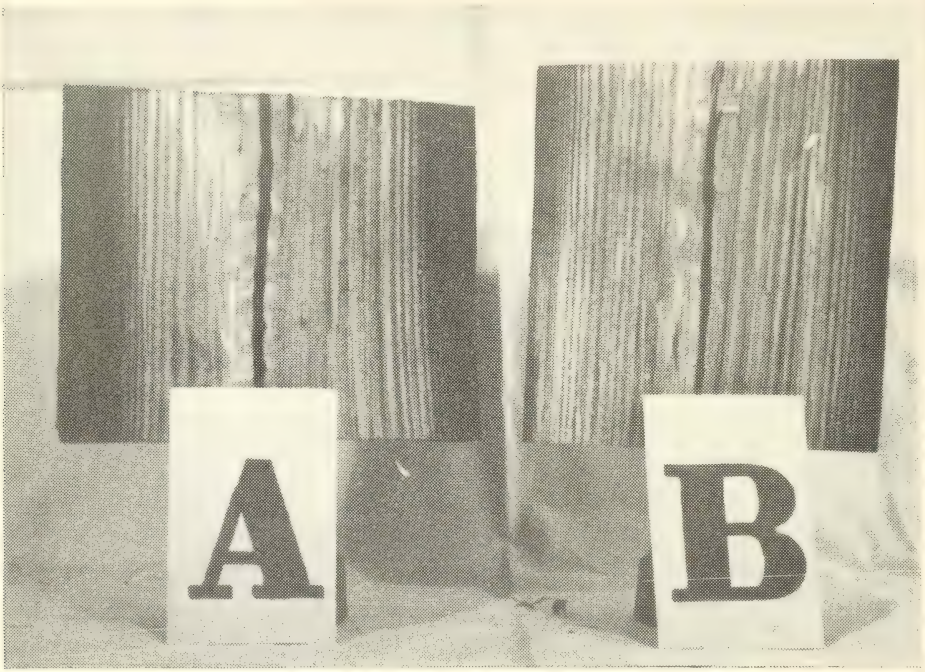

Figure 6. Penetration obtained on pine posts by two methods of treating with creosote. a. Hot and cold bath treatment. b. Dip treatment.

employed. Due to the very dangerous inflammability of the solution of pentachlorophenol in ordinary kerosene, hot water was substituted in the hot tank. A five percent solution of pentachlorophenol was placed in the cold tank. The water was much more difficult to heat to the desired temperature and hold there, so it was decided to hold the posts in the hot tank between three and four hours. At the end of this time the posts were immediately transferred to the cold tank where they remained for one hour. The average absorptions obtained by this treatment are shown in table 3.

Table 3. Average absorption of pentachlorophenol in hot and cold bath treatment.

Kind of post	Schedule	Average absorption, gallons per post	Remarks
Pine	3-1	0.333	Satisfactory
Red Gum	3-1	0.235	Satisfactory
Red Oak	3-1	0.196	Slightly low
Post Oak	4-1	0.320	Satisfactory
Elm	3-1	0.304	Satisfactory

The Forest Products Laboratory[12] says that at least one-half gallon of preservative per post must be retained to give a good treatment. This, however, applies to posts treated full length. The posts in this experiment were treated only half length so that retention between 0.250 and 0.333 gallons per post is considered satisfactory. As with the creosote, half of the posts were subjected to a one hour dip treatment of the top end, the others not being treated.

The use of hot water in the hot bath seems to have no deleterious effect on the absorption of preservative. This is probably due to the fact that most of the water taken up by the posts in the hot bath is in the form of steam when the posts are removed from the hot bath. Plunging the posts at once into the cold

Table 4. Absorptions of pentachlorophenol obtained by cold soaking method.

Kind of post	Soaking time	Average absorption gallons per post	Remarks
Pine	5 hours	0.773	Too much. Reduce time
Red Gum	6 hours	0.583	Too much. Reduce time
Red Oak	6 hours	0.333	Satisfactory
Post Oak	168 hours	0.500	Too much. 96 hours better
Elm	24 hours	0.400	Slightly high.

preservative condenses this steam and creates the partial vacuum which pulls the preservative into the wood.

Cold Soaking Method

Water and thin oil solutions are very readily soaked up by dry wood. This fact makes possible the use of a simple method of treating fence posts with pentachlorophenol solutions. The only equipment necessary is a tank or drum which will permit submerging the post to a point 8 or 12 inches above the ground line. Dry posts left in this solution for 5 to 24 hours will absorb amounts of preservative equal to that absorbed in the hot and cold bath process.

Absorptions obtained by this method at State College are given in table 4.

In the pentachlorophenol tests a 5 percent solution was used. This was obtained by mixing the concentrated solution of pentachlorophenol with ordinary kerosene in the proportions advised by the manufacturers. Other light petroleum oils such as diesel fuel oil are less expensive and should be used when available.

This cold soaking treatment has much to recommend it. It involves very little expenditure of labor in the actual treating process since it is quite possible for a farmer to place a batch of posts in the preservative in the morning, go away and work all day at something else, and remove the posts that night. If he were treating by the hot and cold bath method, he would have to stay close by to maintain the fire.

The experiments at the college have shown that it is possible to obtain absorptions with this method fully equal to those obtained by use of the hot and cold bath. As a matter of fact, absorptions equal to those generally obtained in pressure treating fence posts are possible. The pentachlorophenol solutions used at the college were about six cents cheaper per gallon than the creosote. If some solvent other than kerosene were used, a saving of ten cents a gallon might be effected. Due to the fact that absorption is much faster with some species than others, as shown by Table 4, each specie should be treated separately. This is true of all treating methods. Penetrations obtained in the cold soaking treatment are shown in figure 7.

Water Soluble Preservatives

Research in the field of wood preservation has been done on water soluble chemicals for many years. Some of the most promising of these chemicals have been in use as wood preservatives in arid regions for long periods of time. In such regions they have given good results, simply because the treated wood was not subjected to water in sufficient amounts to wash the chemicals out. Even in very moist climates, the record on at least one such chemical is sufficiently good to warrant its use, especially since the process is so simple and the chemical so inexpensive that a very low cost post results. Certainly this one treatment is better than none.

The water soluble chemicals and methods of application to be discussed here are those which have been used in the experiments at the college. Again, we have no service records here to indicate the expected life of these posts. We are, however, able to compare the costs of the various chemicals and draw certain inferences from service tests elsewhere.

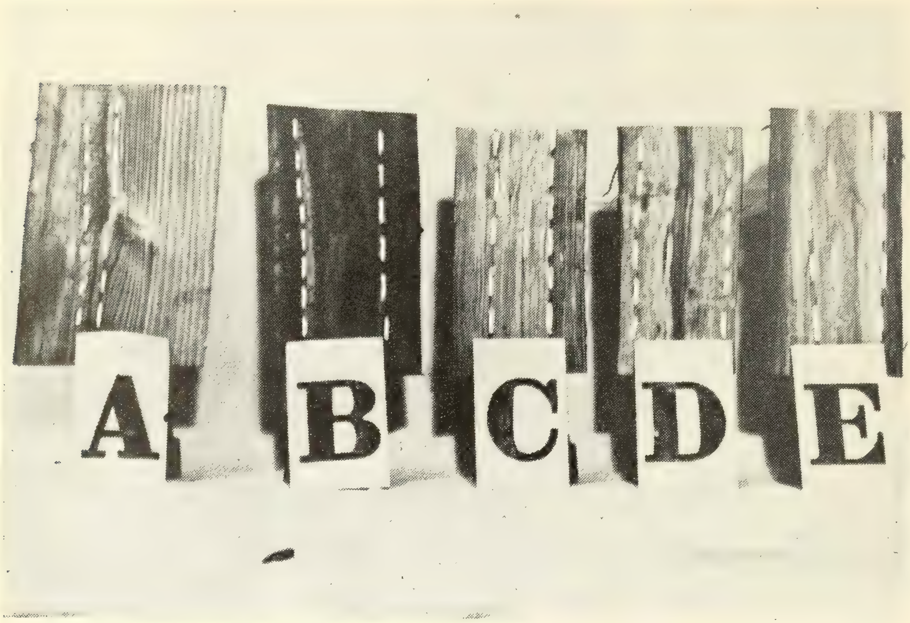

Figure 7. Penetrations obtained in Pentachlorophenol Cold Soaking Treatment. a. Pine, b. Red gum, c. Red oak, d. Post oak, e. Elm.

CHROMATED ZINC CHLORIDE

Chromated zinc chloride is an outgrowth of one of the most used water soluble preservatives, zinc chloride. This chemical has been used long enough to prove that there are excellent possibilities for treating with it in arid regions. Experiments at Clemson, S. C.[8] indicate that it may be used satisfactorily in more moist localities.

The method of application used here has been used in other localities with success. A tank or trough twelve or fifteen inches deep with a rack built up around it to hold the posts upright, is the only equipment necessary. The trough might be placed next to a wall or fence and the posts leaned against this for support. It is important that the treating be done under a shed. Rainwater, falling into the trough, will dilute the solution and ruin the treatment.

A solution made by mixing two pounds of chromated zinc chloride, with one gallon of water, is placed in this tank. One-half gallon of solution should be allowed for each post. Posts should be cut and placed in the solution within twenty four hours after cutting, large end down. The bark must not be removed from the posts. If only the amount of solution for the number of posts to be put in the tank is poured in, the posts should be left until all of the solution is absorbed. If more than enough solution is placed in the tank, the number of gallons absorbed may be measured and the posts removed when the average absorption reaches one-half gallon per post.

This absorption may require only a few hours, or it may extend over a period of a week depending upon the porosity of the wood and the rate of drying of the top of the post. The solution is pulled up into the post by capillary action. As the post dries at the top, the native liquids are pulled up in the post and the preservative solution in turn moves up through the pores of the wood.

Upon completion of absorption and removal from the trough, the posts are stood up, top end down, for two to four weeks to permit any excess solution in the butts to flow down into the top. The posts are now ready for placement.

Chromated zinc chloride and zinc chloride may be obtained from any chemical house.[2] Zinc chloride is slightly less expensive and on the basis of service tests at the Harrison Experimental Forest, somewhat better. This treatment, while it will not give as durable posts as oil treatments, is very simple, consumes little time, and is inexpensive. It will effect considerable saving over the practice of no treatment at all.

THE OSMOSE PROCESS

The Osmose Wood Preserving Company, of Buffalo, New York, has developed a process, and patented two preservatives for use with it, which makes use of the principle of osmosis. Osmosis is a natural process occurring in plants and animals whereby two solutions of different strength separated by a thin membrane such as a cell wall, tend to equalize. That is, the chemicals in the stronger solution move through the membrane into the weaker solution until there is an equal concentration of chemical substance on either side of the membrane.

The application of this process in wood preservation consists simply of coating the outside of a green post or piece of wood with a strong chemical solution and then placing the wood under a waterproof, more or less airtight cover. Osmosis sets in and over a period of 30 to 90 days the chemicals placed on the outside of the wood gradually become incorporated.

Two patented chemical mixtures are used for treating posts by this method.[3] One is a dry salt which is used to make a water solution applied to the post by brushing or dipping. The other is a tar solution, containing the same chemicals, which is applied only to the groundline area of the post with a brush.

Osmosalts

This is the mixture of chemicals which is used to make a water solution to be applied by brushing or dipping. The mixture used in the experiments at State College was 4 parts of water to 3 parts of dry chemical. This was applied to the posts with a cheap 4-inch paint brush, the posts being closely piled as the preservative was applied. After all posts were piled and treated, the stack was covered with waterproof tar paper and earth was banked up around the bottom to exclude air. The posts remained in this stack for 75 days before the cover was removed. Good penetration was obtained on all species. The method of piling and preservative application is shown in figure 8. Extent of penetration is shown in figure 9.

Posts which are being treated by this method must be cut and peeled not over twenty-four hours before treatment. This is a decided drawback from the farmers' standpoint because he cannot always afford the time during the proper peeling season.

Osmoplastic

This preservative is applied only to a small section of the post about twelve inches below groundline and three inches above groundline. The posts, which must be treated within 24 hours after cutting. are brought in with the bark on. The bark is then peeled only from the section to be treated and the tarlike solution of Osmoplastic painted on heavily with a paint brush. A small piece of waterproof paper is then wrapped tight-

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[2] E. I. Du Pont de Nemours and Co., Inc. Wilmington, Delaware, donated the chemicals used in the State College experiments.

[3] Sufficient of both of these preservatives to carry out the tests was contributed by the Osmose Wood Preserving Co.

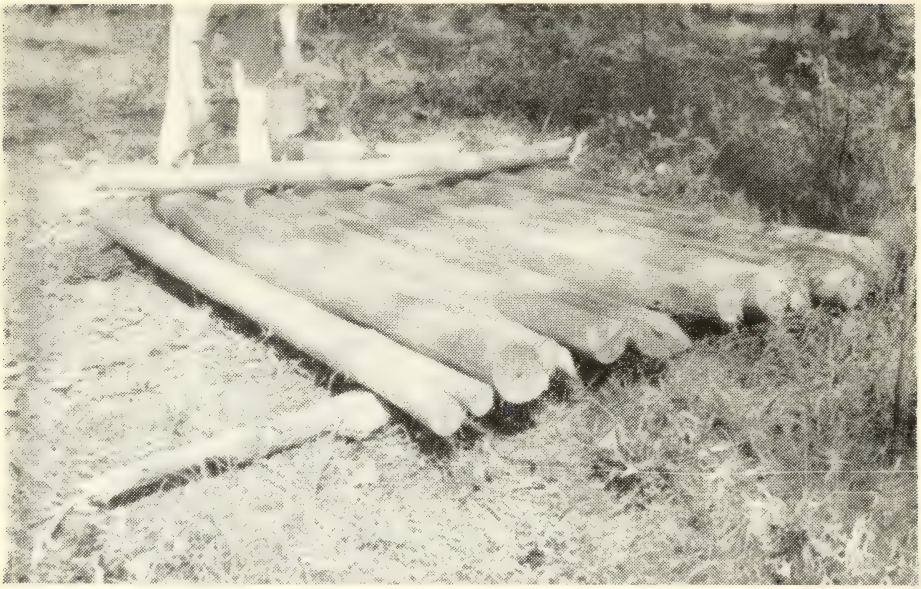


Figure 8. Osmosis Method with Osmosalts. Method of piling and application.

ly about the treated section of the post and tacked in place. The post, ready for treatment and after treatment is completed, is shown in figure 10. After treatment the posts should be stood up and allowed to dry for 30 days before placement.

Service records on posts treated in this manner are not sufficiently long to indicate whether or not it will prove economical.

COSTS OF FENCE POSTS

In the past much has been written concerning preservative treatment of fence posts without mentioning the various items of cost which go into treated and untreated fence posts. One of the main objectives of the work at State College has been to collect data on the man-hour requirements of each of the jobs involved in harvesting and treating fence posts. Since some preservative treatments require posts which have been peeled, stacked and seasoned, others require posts peeled but still green, and still others require posts green with the bark on, data on the separate job of felling and bucking, peeling, hauling and stacking, is desirable.

Each treatment, too, differs from every other in the amount of labor required in the process. Some preservatives cost more than others and a good post may require more of one preservative than another. All of these factors become items of cost, and cost to the farmer is a very important consideration.

Labor requirements in this study have been recorded in terms of man hours so that any prevailing wage rate could be applied. The work was actually done by day labor paid at the rate of forty cents per hour. Labor costs in the following tables then are obtained by multiplying the total man hours expended by the hourly rate of forty cents. These costs may be adjusted to prevailing wage rates in any similar area simply by substituting the prevailing hourly rate for the hourly rate of forty cents used in these tables.

No attempt has been made to separate the costs by species worked with. Admittedly, it is less expensive to make posts from pine than from any of the other species used but it is hoped that hereafter a good many fence posts will be harvested from the gum, red oak, post oak, elm, and other low grade hardwoods. The cost figures set forth herein will be applicable to these species.

There is no doubt that all of these costs are higher than they would be with experienced woods labor. The labor used on the project consisted of Negro farm hands, most of whom had never done any woods work. Peeling was for all of them a new task, consequently it was accomplished with the expenditure of much more time than would be required with labor accustomed to peeling. However, it was considered desirable, in this study, to make use of part time farm labor. The study was designed to furnish information for the farmer and the use of trained woods labor would have led to a fallacy in the costs which would have been misleading. Any farmer with his ordinary farm labor can secure his posts at a cost not to exceed those set up herein. Many men, who have hands more accustomed to woods work, will obtain their posts at a cost considerably less than this.

Hot and Cold Bath Treatment

The factors contributing to the costs of this method of treating are cost of plant, labor cost (including cutting, peeling, hauling, seasoning and treating), cost of preservative, and cost of fuelwood.

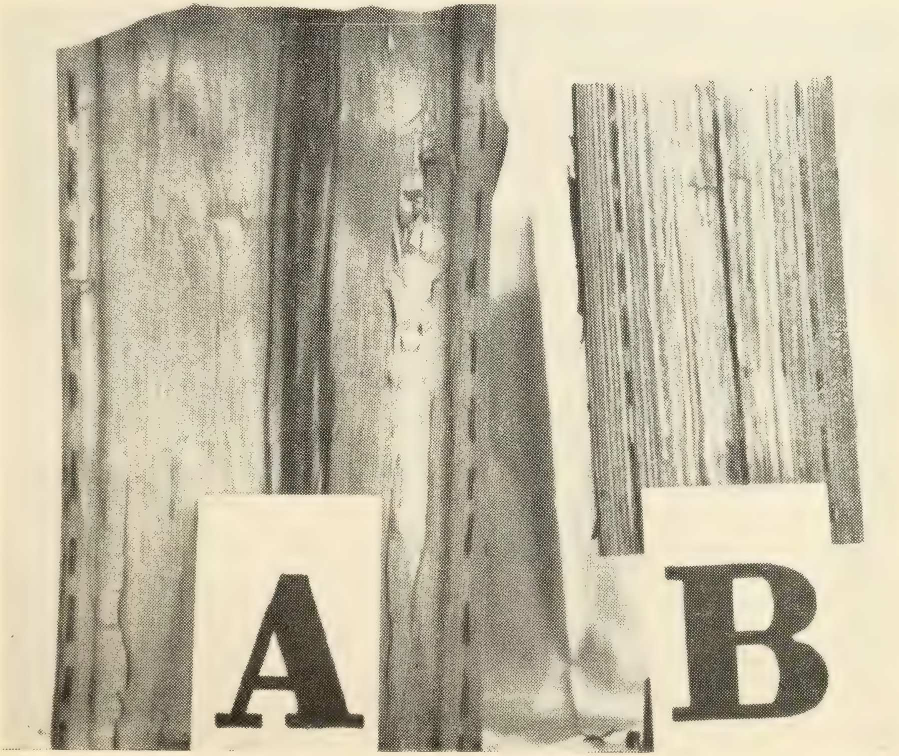


Figure 9. Penetration obtained in Osmosalts treatment. a. Red gum. b. Pine.

Table 5. **Labor costs of fence post production and treatment by various methods.**

Operation	No. of posts	Man hrs. expended	Man hrs. per post	Hourly rate	Labor cost per post
Cutting	1830	310	0.1694	0.40	$0.068
Peeling	1480	575	0.3885	0.40	0.155
*Hauling and stacking	1830	100	0.0546	0.40	0.022
Creosote—hot and cold bath	150	20	0.1333	0.40	0.053
Creosote—dip	150	10	0.0666	0.40	0.027
Osmosalts—brush	150	90	0.6000	0.40	0.240
Osmoplastic—brush	150	42	0.2800	0.40	0.112
Zinc Chloride—steeping	150	5½	0.0366	0.40	0.015
Pentachlorophenol—hot and cold bath	150	26	0.1733	0.40	0.069
Pentachlorophenol—cold soak	150	6½	0.0433	0.40	0.017

*Hauling costs will vary with length of haul and equipment used. In this study the distance averaged about one mile. About ¼ of the posts were hauled on a pickup truck, 2/3 of them on a 1½ ton truck and the balance with a team and wagon.

As mentioned previously, the experimental plant at Mississippi State College cost approximately $200.00. Actual cost was $191.50 which is broken down as follows: tanks, $28.50 (an old 500 gallon gasoline tank cut in half crosswise to make two 250-gallon tanks about 4½ feet deep); other materials (roofing, etc.) $73.00; labor $50.00; and supervision, $40.00.

The farmer building his own plant might not include any cost for supervision. If he put no roof over the tank he would reduce the labor cost by 50 percent. He might then, build a workable plant, without any shed, for a figure close to $75.00. Such a plant is not to be recommended since the treating will presumably be done in the fall and winter when rain is probable. Work can go right on if there is a shed over the tanks.

If we assume a depreciation charge of one cent per post and a cost of $200.00 for the plant, we have to treat 20,000 posts to pay for the plant. This charge for depreciation would probably run closer to 3 or 4 cents per post.

The labor cost on posts treated by this method is high because of the necessity of peeling and of maintaining a fire under the hot tank all of the time while treating. From table 5 the cost per post for labor would run between 29 and 31 cents.

Preservative cost varies with the preservative used. Grade I coal tar creosote costs 33-1/3 cents per gallon in 50-gallon lots. If the desirable absorption of ¼ gallon per post (butt treatment only) is obtained, the cost per post would be slightly over 8 cents per post. When the top is then given a dip treatment, the preservative cost would approach 9 cents per post.

Pentachlorophenol (1 to 10 concentrate) costs $2.00 per gallon. Mixed with 10 gallons of kerosene at 10 cents per gallon, the cost of 11 gallons of preservative solution becomes $3, or 27.2 cents per gallon. This cost may be reduced to 23.6 cents per gallon by use of diesel fuel at 6 cents per gallon, as a solvent. If the desired absorption of ¼ of a gallon per post is obtained, the cost of preservative would be about six cents. Here again, the top treatment would run the cost per post up to about seven cents.

Considerable fuelwood is consumed in heating the hot tank and maintaining it at the proper temperature. Some difference would occur, dependent upon the kind of wood used for fuel and whether creosote or water was used in the hot tank. About one-half cord of wood per hundred posts was used in the experiments at State College and the cost of this wood at the plant was figured at $5 per cord. Cost of fuel per post then, was 2½ cents. Three cents is thought to be a better figure for the pentachlorophenol treatment because of the longer time required to heat the water and the necessity of a hotter fire to maintain it at the required temperature.

Some charge for depreciation of equipment other than the treating plant should be made. One cent per post should cover all expenses other than those discussed before. This charge will apply to all treatments.

Table 6 gives a comparison of the cost of the hot and cold bath method with creosote and with pentachlorophenol.

It should be emphasized that the cost of preservative included in the above table is the cost only of the preservative actually absorbed. This method of treatment (with tanks the size of those at State College) requires an additional seventy gallons of preservative in the cold tank. In the case of creosote, where the oil is used in the hot tank, another additional 100 gallons of preservative is needed. The initial costs then should be increased as follows:

Table 6. Comparison of the cost of creosote and pentachlorophenol treatments applied by the hot and cold bath method.

	Creosote	Pentachlorophenol
Plant depreciation	$0.03	$0.03
Labor	0.29	0.31
Preservative	0.09	0.07
Fuelwood	0.025	0.03
Equipment depreciation	0.01	0.01
Total	$0.445	$0.45

Creosote treatment:
170 gallons creosote at $0.333 = $56.61
Pentachlorophenol treatment:
70 gallons pentachlorophenol 5% solution at $0.236 = $16.52.

There is no way of distributing these figures as a cost per post because the leftover oils may be saved and used again. The factor of initial cost, however, is heavily in favor of pentachlorophenol.

Posts treated with creosote by the Hot and Cold Bath Method are good for 20 years. It appears likely that pentachlorophenol treated posts will be just as good. The cost per post per year will be in both cases only slightly over two cents.

Creosote Dip Treatment

This treating method involves labor costs of cutting, peeling, hauling, seasoning and treating a small cost for preservative, and the cost of equipment depreciation. No cost of plant is involved because any old drum or barrel may be used provided it does not leak and will permit submersion to half the length

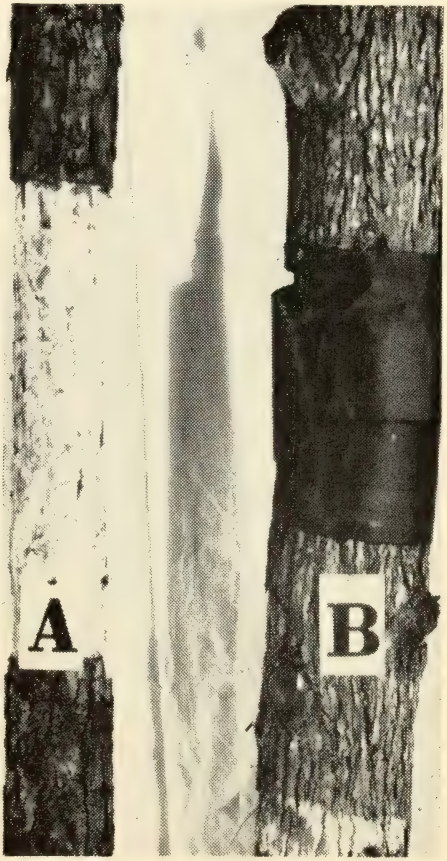


Figure 10. Osmoplastic Method of Treatment
a. Post peeled and ready for treatment.
b. Treatment complete.

of the post. Little preservative cost is incurred because there is negligible absorpton and penetration. One gallon of preservative will easily treat ten posts. Table 7 shows a breakdown of the costs of treating by dipping in the experiments at State College.

Posts so treated might be expected to last five years. The cost per post per year, therefore, is slightly over 5 cents or 3 cents more than for posts treated by the hot and cold bath. The dip treatment is little better than no treatment and it involves the same costs of preparation as are incurred with the hot and cold bath.

Table 7. Cost per post of dip method of treatment with creosote.

Labor	$0.27
Preservative	0.03
Equipment depreciation	0.01
Total	$0.31

Osmose Treatment

The osmose treatment with Osmosalts is more expensive than the hot and cold bath or dip methods. The same costs of preparation are incurred. No plant is necessary, but this saving is more than taken up in the labor of treating. The preservative is more expensive too, and it is doubtful if posts so treated will give as long service as creosoted or pentachlorophenol treated posts. A dipping process, instead of a brushing process, would undoubtedly give much lower costs.

Table 8 breaks down the cost of the brush treatment with osmosalts. For comparative purposes it is assumed that the labor involved in dipping would cost the same as for dip creosoting and a figure which may be valid for dip treatment is also given. Some saving of preservative would be affected by use of a dip method but no attempt to estimate this is made.

The saving in preservative on the dip method might run to 5 cents per post. Even this much would still mean a cost of at least 41 cents per post. For the brush method the cost per post per year would run from 4½ to seven cents if we assume a 10 to 15 year service life for these posts. Ten-year service records are available which indicate that these posts may last longer.

Table 8. Cost per post of Osmose treatment by brush and dip methods.

	Brush	Dip
Labor	$0.49	$0.27
Preservative (50 lbs. at 52 cents)	.16	.16
Paper (covering)	.02	.02
Equipment depreciation	.01	.01
Total	$0.68	$0.46

The Osmoplastic ground-line treatment is somewhat less expensive since this method does not involve so much labor of peeling. The cost break-down on this method is as follows in table 9. The preservative costs $5.25 per gallon and two and one-half gallons were required to treat 150 posts.

Service tests in south Mississippi show that some of the posts treated by this method have decayed within four years. It is believed that a five-year average life of such posts will be good under the climatic and soil conditions in Mississippi. This would make the cost six cents per post per year.

Table 9. Costs of Osmoplastic ground-line treatment.

Labor	$0.20
Preservative	0.09
Equipment depreciative	0.01
Total	$0.30

Chromated Zinc Chloride Steeping Treatment

This method of treatment is one of the least expensive of any tested at Mississippi State College during 1946. No cost of peeling enters into the total cost and the chemical used is inexpensive. No elaborate plant is required either, any trough or barrel which will hold 10 or 15 inches of water being satisfactory. Chromated Zinc Chloride in 50-pound lots costs 15 cents per pound and Zinc Chloride 14¼ cents per pound. Costs of the posts treated by the steeping method at State College are shown in table 10.

It will be noted that an average absorption of 1.36 pounds of salts per post was obtained. If the recommended absorption of 1 pound per post had been adhered to, preservative cost and total would have been reduced five cents. The total would then be 26 cents per post. Service tests elsewhere indicate that a ten-year average life of post may be expected. This would give a cost per post per year of 2.6 cents.

Table 10. Costs of chromated zinc chloride steeping treatment.

Labor	$0.10
Preservative (1.36 lbs. per post)	0.20
Equipment depreciation	0.01
Total	0.31

Pentachlorophenol Cold Soaking Treatment

All of the costs of preparation incident to the hot and cold bath treatment are incurred with this method, but the cost of actual treating is somewhat less. Preservative costs are about the same, depending of course upon how long the posts remain in the solution and how much preservative they absorb. Table 11 shows the cost of this treatment when absorption is held to the desired ¼ gallon per post.

Posts treated in this way may be expected to last fully as long as posts treated by the hot and cold bath method since just as good absorptions are obtained. While service records are only ten years old, there is every indication of a 20-year average life. If posts treated in this manner will last so long, the cost per post per year is only one and six-tenths cents.

Table 11. Costs of pentachlorophenol cold soak treatment.

Labor	$0.26
Preservative	0.06
Equipment depreciation	0.01
Total	$0.33

Table 12 constitutes a summary and comparison of the costs of treating by the various methods.

Community Treating Plants

Thus far all discussion in this treatise has centered about methods of treatment and plants which may be used by an individual farmer. There is, however, considerable interest about the state in small commercial or cooperative treating enterprises designed to fit the needs of communities. Without a separate study on the needs for such plants, costs of operation, etc., it is hard to make any definite recommendations. Some information, however, has been collected in connection with the other work on treating and may be of value to persons interested in these small scale treating plants.

Most Mississippi counties will probably support a profitable small plant. A good county has 10 or 12 townships each of which would require about 100,000 posts to divide it into 160 acre lots. If we accept the anticipated demand of 6,000,000 posts a year for the state and divide by the number of counties, we arrive at an annual county demand for nearly 75,000 posts. A good efficient plant of the hot and cold bath type can probably handle about 600 posts per day. If nothing but posts were treated in this plant, a demand of 180,000 per year would be necessary to insure continuous operation. There is no reason, however, why all kinds of construction material, bridge timbers, etc., should not be handled at the same plant.

Types of Plants Adapted to Community Use

There are almost as many ideas about the most suitable type of small scale treating plant as there are persons interested in such plants. No one, however, (except the manufacturers) recommends small pressure plants. They undoubtedly give superior treatment, but the cost of such a plant is excessive and highly trained per-

Table 12. Summary of all costs of treating fence posts by various methods used at Mississippi State College in 1946, on a cost per post basis.

Method	Plant depreciation	Labor	Preservative	Fuel	Equipment depreciation	Total	Expected av. life years	Cost per post per year
Creosote hot and cold bath	$0.03	$0.29	$0.09	$0.025	$0.01	$0.445	20	$0.022
Pentachlorophenol hot and cold bath	0.03	0.31	0.07	0.03	0.01	0.45	15 to 20	0.022 to 0.030
Creosote dip	—	0.27	0.03	—	0.01	0.31	5	0.062
Osmosalts, brush	—	0.49	0.18	—	0.01	0.68	10 to 15	0.068 to 0.045
*Osmosalts, dip	—	0.27	0.18	—	0.01	0.46	10 to 15	0.046
Osmoplastic, brush	—	0.20	0.09	—	0.01	0.30	5 to 8	0.060 to 0.040
Chromated zinc chloride, steeping	—	0.10	0.15	—	0.01	0.26	10	0.026
Pentachlorophenol, cold soak	—	0.26	0.06	—	0.01	0.33	15 to 20	0.016 to 0.022

*Theoretical. See text.

sonnel is required to operate it. Estimates obtained on such plants during the course of this investigation ranged from $20,000 to $75,000. No one would be justified in investing so much in a plant to serve only a community.

The only other alternative is some large scale adaptation of the hot and cold bath plant. The cold soaking process with pentachlorophenol would not be satisfactory because it consumes too much time for use in a commercial operation. Continuous production is an important factor in the economical operation of these small plants.

Georgia's vocational agriculture teachers have set up and are operating a number of community creosoting plants which are based on the hot and cold bath process. Most of these plants consist of a single tank made of reinforced concrete or steel plate and heated through coils in the bottom which carry steam from a gin or community cannery. In operation the posts are heated in the creosote, the steam turned off and the posts and creosote allowed to cool together. There are some disadvantages to this method, chief of which are the facts that absorption is harder to control and only one charge per day can be run through the plant. Their tanks are usually 4 feet deep x 4.5 feet wide and range in length from 15 to 30 feet. Posts are handled by an overhead travelling hoist.

The Delta Branch Experiment Station, Stoneville, Mississippi, has an experimental installation which works on the true hot and cold bath principle of two tanks. These tanks are semi-circular in cross section, 5 feet wide at the top x 2.5 feet deep and about 20 feet long. The tanks are placed end to end with about four feet between them. A brick, dutch-oven furnace was constructed under one. A travelling, overhead hoist is used to pick up bundles of posts, place them in the tanks and transfer them from one tank to the other. With some modification, this design appears to be satisfactory for small scale community plants.

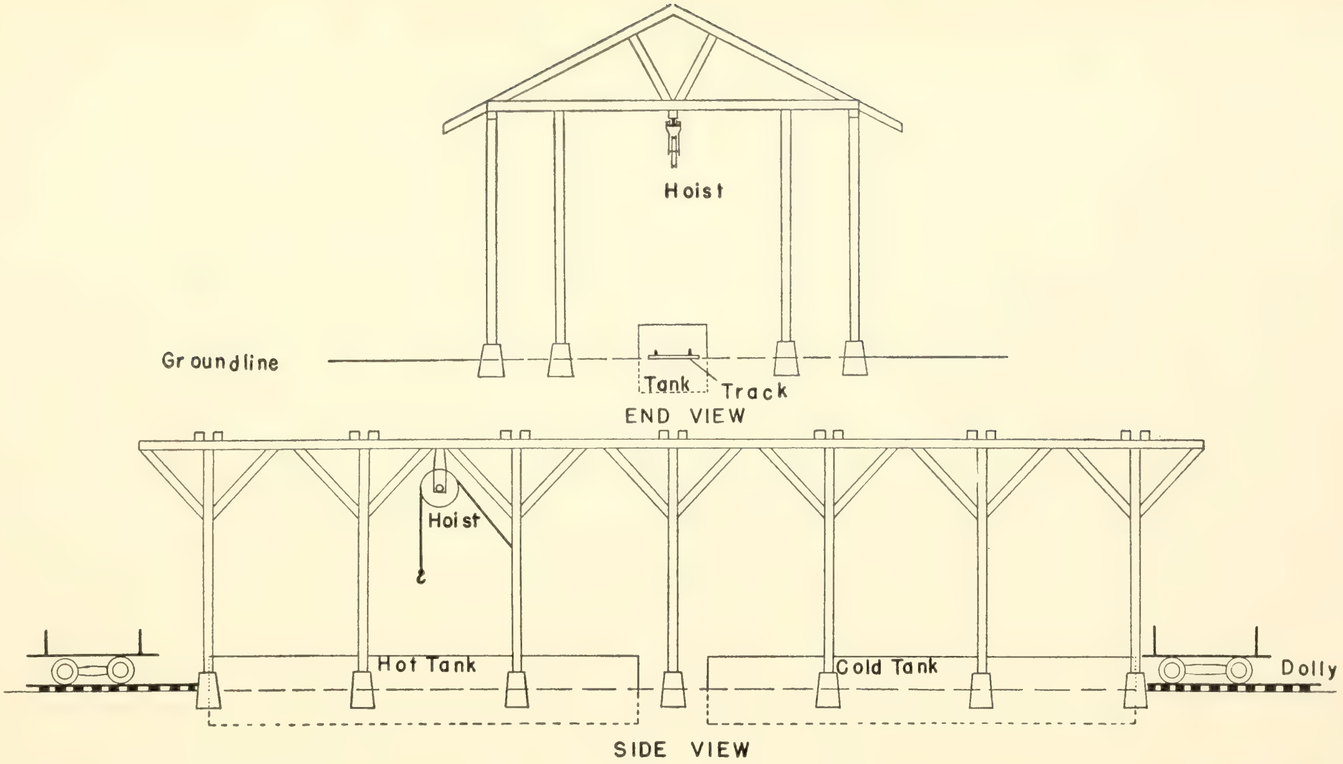
A satisfactory plant might consist of two rectangular steel tanks 4 feet deep by 4 feet wide by 25 feet long, set two feet in the ground and heated with steam coils. Steam might be supplied by a gin or sawmill boiler if available. The cold tank should be supplied with coils too, so that exhaust steam from the hot tank or cold water may be used to raise or lower the temperature of the oil in the cold bath. Average absorptions will be easy to check if a gauge, reading in gallons, is installed on the cold tank. A thermometer should be placed on the hot tank. An overhead, traveling hoist should be provided for moving charges, and several dollies would be a distinct advantage in moving charges to the tanks and away from them. Charging the tanks would be facilitated if oil storage tanks of carload capacity were provided. A shed should cover the entire plant. Posts may be treated half-length only by providing a removable skeletal partition to divide each tank into compartments 4 x 5 feet. Some method of exerting pressure to submerge charges to be treated full length is necessary. A hinged rack could be devised which would be operated by means of cables and pulleys, the power to be furnished by the overhead hoist.

Figure 10 and 11 show the diagrammatic layout of such a plant.

An advantageous adjunct to any small treating plant would be a small, mechanical, peeling machine. Several have been developed, but the field is still wide open. A machine somewhat similar to the pole sizing machine in use at large treating plants, but on a smaller scale, might be satisfactory.

Costs of Operation

A very complete plant sufficient to serve the needs of a county could be built for a cost of $10,000. Such a plant would have a life of at least 10 years. It would have a capacity of at least 600 posts per


Hoist
Groundline
Tank
Track
END VIEW
Hoist
Hot Tank
Cold Tank
Dolly
SIDE VIEW

DIAGRAMMATIC VIEW OF SMALL PLANT

Scale 1" = 5'

FIGURE II.

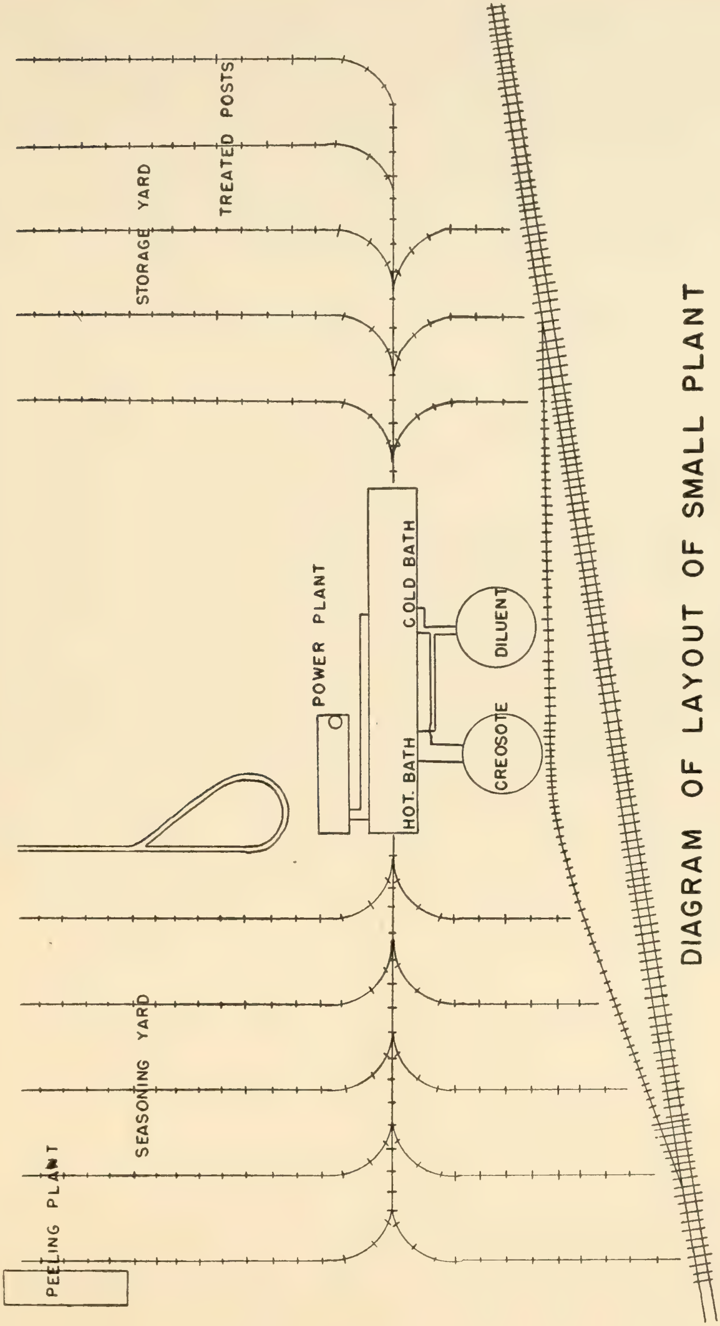

TREATED POSTS
STORAGE YARD
POWER PLANT
COLD BATH
HOT. BATH
DILUENT
CREOSOTE
SEASONING YARD
PEELING PLANT

DIAGRAM OF LAYOUT OF SMALL PLANT

FIGURE 12.

day. In a year's time, operating 300 days out of the year it would treat the equivalent of 180,000 posts. The plant could be operated by three men. Labor costs might be 85 cents an hour for the trained operator and 65 cents an hour for the other two men. A supply of posts, necessary to start operations might cost 10 cents each. An estimate of the daily and per post cost of operation is given in table 13.

Profit of 3 cents on the post (or post equivalent) would return over 50 percent of the investment to the operator in a year's time. A system whereby the farmer could bring in green, unpeeled posts and trade them, paying the difference in cash, for treated posts, would be very advantageous.

The best preservative for use in these plants will probably be creosote as it is somewhat cheaper in carload lots than is pentachlorophenol. The cost of preservative may be reduced by diluting the oil in the hot bath with fuel oil, crank case oil, etc., in the proportion of 1 to 1.

All of the figures and ideas presented in this section are theoretical and are based on the author's best judgment rather than on any actual operations. This must be borne in mind when attempting to use them in any contemplated plant construction or operation. The local conditions with respect to demand for treated posts, labor, equipment cost, and operating costs should be carefully investigated. We have merely attempted here to outline some of the possibilities.

Table 13. Estimated daily and per post cost of operation of small commercial hot and cold bath plant.

	Daily	Per post (600 posts per day)
Depreciation	$ 3.33	$0.005
Operating costs, fuel, etc.	12.00	0.020
Labor	17.20	0.030
Preservative	25.50	0.042
Creosote at 17 cents gal. in carload lots		
Post cost	60.00	0.100
Total	$118.03	$0.197
Allowance for taxes, etc.		.013
Total		.220
Profit		.03
Cost of post to consumer		$ .25

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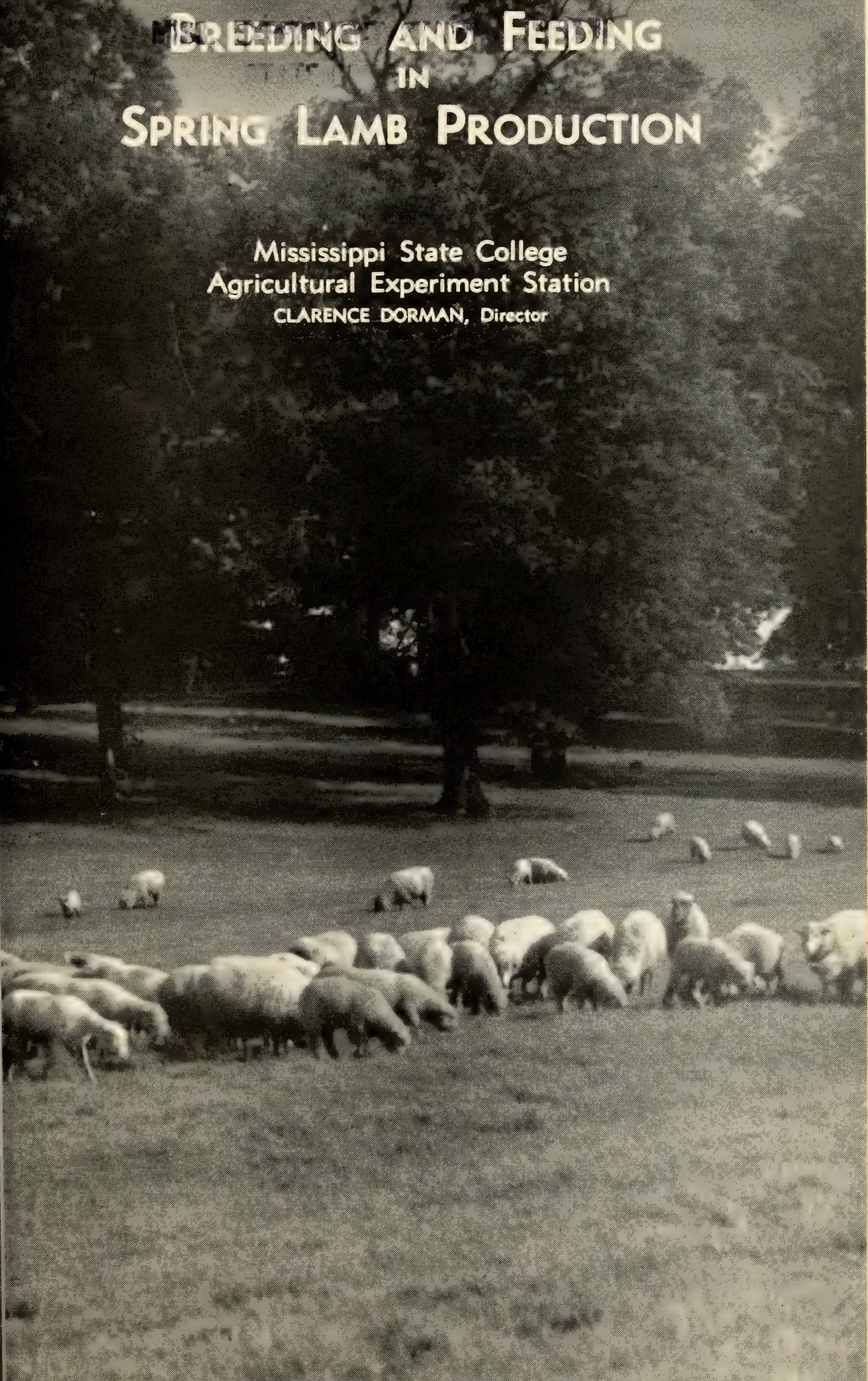
BREEDING AND FEEDING IN SPRING LAMB PRODUCTION



Mississippi State College
Agricultural Experiment Station
CLARENCE DORMAN, Director

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Breeding and Feeding in Spring Lamb Production

By **HENRY H. LEVECK**

Profitable lamb production in Mississippi depends to a great extent on the ability of producers to have lambs of desirable conformation and quality reach ideal market weights and finish in time to sell on the April and May markets.

Lambs coming to market at this time usually find the highest prices, due to the public's greater demand for lamb during these months, and to the fact that few lambs are finished for market at this time. Fed lambs from the corn belt have been marketed in previous months, and it is not generally practicable for producers of milk fat lambs in the North to have lambs ready for market this early in the season.

The marketing of lambs during April and May offers three other advantages for Mississippi producers. In the first place, it is easier to maintain bloom on lambs before the weather becomes too warm. Secondly, lambs take full advantage of our good spring clover pastures, directly as feed for themselves, and indirectly as feed to encourage their dams in milk production. Thirdly, lambs are marketed before the warm weather build-up of parasites, thereby eliminating many parasitic troubles that one would have to combat in marketing later in the summer.

This bulletin includes the results of four tests which have been completed by the Mississippi Experiment Station to study some of the most important factors influencing the economical production of high quality spring lambs. It is arranged in four parts:

Part 1. Grain supplement in the production of spring lambs on good pasture.

Part 2. A study of the influence of type and breeding in spring lamb production.

Part 3. The value of Corriedale, Hampshire, and Southdown breeding in spring lamb production.

Part 4. Northwestern, Southwestern, and Corriedale-native ewes in wool and spring lamb production.

PART I

Grain Supplement In the Production of Lambs on Good Pasture*

Does it pay to feed grain to lambs on good pasture? This question is often asked by producers of milk fat lambs in Mississippi.

The demand for well finished lambs is evident by the "spread" or difference in the market value of choice, good, and medium grades of lambs. Finish, at desirable market weight, early in the year, are perhaps the three most important factors in spring lamb production. The importance of these factors prompted this study to determine the influence of grain feeding on the rate of gain and finish of lambs being produced to market at weaning time.

The general objective of this test was to study the influence of supplementing pasture with grain, both when fed to the lambs and when fed to the ewes, on the rate of gain of lambs, the degree of finish at time of slaughter, and the quality and palatability of the meat produced. The following lots were compared:

Lot 1. Pasture alone for ewes and lambs.

Lot 2. Pasture for ewes and lambs, and the lambs creep-fed cottonseed meal.

Lot 3. Pasture for the ewes and lambs, and the lambs creep-fed a mixture of corn, oats, and wheat bran.

Lot 4. Pastures for both ewes and lambs, and the ewes fed a daily ration of 3/4 pound of corn and 1/4 pound of cottonseed meal. (This lot was used during 1929 and 1931, and the results were used in this study to determine the possibility of increasing the milk flow of the ewes by grain feeding, thereby increasing the rate of gain and finish at market time of the lambs.)

Methods Used in Test

The lambs used in each of these tests were out of native, first cross, second cross, and high grade Southdown ewes. All ewes were handled as a group, other than during the time the lambs were on test. On June 1 of each year, lambs that had not previously been removed from their dams were removed and sold or put in a separate pasture and retained for flock replacements. The ewes were watched for 8 or 10 days and ewes producing large quantities of milk were milked to prevent spoiled udders. The ewes were then placed on good pasture, largely of dallis and Bermuda grass, approximately 90 percent dallis grass, where they remained until July 1.

The pasture used during the month of June was of sufficient quality to cause the ewes to gain from 6 to 8 pounds each, which is considered sufficient gain in weight to serve as a "flush". This flushing tends to speed up conception and to result in an increased number of twin lambs being produced.

On July 1 purebred Southdown rams were turned in with the flock. The rams were left with the ewes until approximately October 1. The ewes remained on pasture until December 1 when lambing began, and the flock was moved to winter quarters where oat pasture was provided. During the breeding season and prior to lambing time (July 1 to December 1) the ewes were kept on permanent pasture where an abundance of forage was available at all times. The plants present were largely dallis grass with a small amount of Bermuda grass.

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*This project was conducted in cooperation with Bureau of Animal Industry, United States Department of Agriculture, as one of the investigations in the cooperative projects, "A Study of the Factors which Influence the Quality and Palatability of Meat." Only the production phases are given in this report.

The ewes were corralled in a dog-proof corral each night. They had access to salt and clean pond water. Internal parasites were controlled by drenching the ewes once every two weeks with four ounces of a one percent solution of copper sulphate. This method of controlling internal parasites has been replaced by the more easily administered Phenothiazine-salt mixture.

Cattle and sheep were run together on the same pasture with no noticeable ill effect to the cattle or sheep. It was felt that the pasture was improved for grazing by the cattle, as the sheep's preference for a variety of forage caused them to consume many weeds that were unpalatable to cattle, thereby enabling more desirable plants to grow.

The lambs used were yeaned largely in December and January. Previous to the initial date of the experiment the lambs with their dams had free access to a limited amount of oat pasture. In addition to the oat pasture the ewes were fed 1/2 pound of cottonseed meal and 1 1/3 pound of Johnson grass hay. As long as there was an abundance of oat pasture the ewes refused approximately 60 percent of this hay. Ewes and lambs had access to salt and to deep well water. No parasite treatment was given during this time. Both ewes and lambs were housed in an open shed type barn. The period in winter quarters extended from approximately December 1 to March 15.

The lambs were put on test at the start of the pasture season, approximately March 20, when the lambs averaged 40 pounds, and continued on test until the lambs averaged approximately 70 pounds liveweight. The permanent pasture used during the period of the test consisted of wild barley, bur clover, yellow hop clover, white clover, Kentucky blue grass, Bermuda and dallis grass; yellow hop clover furnished approximately 75 percent of the forage during this period. Both water and salt were available at all times.

During the test period the lambs were drenched once every two weeks with a one percent copper sulphate solution. Each lamb received 1 1/2 ounces of this solution at 40 pounds liveweight, and an additional 1/2 ounce for each 10 pound increase in liveweight until a four ounces dose was given. This method was found satisfactory for controlling stomach worms in lambs, but was time consuming and not too popular with our producers. This treatment has been replaced by the Phenothiazine-salt mixture. No barns or sheds were available; the flock was corralled in a dog proof corral each night.

Since the pastures used in this study were of different sizes, and although within a half-mile radius of each other, they did vary as to the soil type, fertility, and plant population; it was therefore decided to alternate the lambs so that by the end of three years each group would have been confined in each pasture for one experimental period. At the completion of three tests it was decided to conduct a fourth test, rotating the lots at the end of every two weeks. Lot 4, which was conducted only two years, was pastured in a fourth pasture and was not included in this rotation.

At the beginning of the test all lambs were carefully selected and divided equally as to breeding of dams, weight of lambs, and number of twins in each group. The lambs were individually weighed on three consecutive days, at the beginning and end of the test. The average of these three weights were used as the initial and final weights. Monthly weights were secured during the test.

At the conclusion of the test all lambs were shipped to Beltsville, Maryland, where they were slaughtered and information secured as to carcass weights, dressing percent, and carcass grade. The right leg from each lamb carcass was cooked by a standard method and information was secured as to the quality and palatability of the meat. This work was conducted jointly by the Bureau of Animal

Figure 1. Winter pasture of small grains reduces the feed bill and furnishes high quality feed for both ewes and lambs.

Husbandry and the Bureau of Home Economics.

Results of these four tests and the average for the four tests are shown in tables 1 and 2. Table 3 shows the influence of the different pastures on the rate of gain, dressing percent, market grade, market value, and feed per hundred pounds of gain in each of the lots handled during this experiment.

DISCUSSION OF RESULTS

Creep Feeding

The lambs were not confined to the area of the creeps but had access to them at all times. The creeps were in the corrals where the ewes and lambs were confined for some 14 hours out of each 24 hours. It is probable that the creep-fed lambs failed to consume enough grain to make any material difference in the rate of gain and finish of the lambs at time of marketing. It was observed that the lambs were very full when closed in the corral in late afternoon and that they seemed more anxious to rush out to the clover pasture when the corral was opened in the morning than to remain near the creep where the grain was available.

Pasture

In studying table 3 with reference to the influence of pasture on lamb production, it will be noted that there was considerable difference in the size of the pastures used in these tests. Cattle were in each pasture with the sheep so that the livestock unit per acre was comparable. An abundance of forage was available in all pastures throughout the test period. The center east pasture and the woods pasture contained a higher percent of clover and were freer from weeds and other undesirable plants than was the west woods pasture. While there was an abundance of clover in the west woods pasture, the natural tendency for sheep to consume a variety of plants might have caused the ewes to consume many of these plants, undesirable from a nutritive point of view, leaving less room

Table 1. Pasture vs. grain and pasture in spring lamb production: 1928-29-30-31.

	Pasture alone	Lambs creep-fed cottonseed meal	Lambs creep-fed grain mixture	Ewes fed corn and cottonseed meal
1928	Lot 1	Lot 2	Lot 3	Lot 4
Length of test (days)	64	64	64	—
Number of lambs	20	20	20	—
Age at slaughter (days)	165	158	—	—
Average initial weight (lbs.)	38.3	38.45	38.5	—
Average final weight (lbs.)	71.3	69.4	70.35	—
Average gain (lbs.)	33.0	30.95	31.85	—
Average daily gain (lbs.)	.514	.484	.498	—
Feed per cwt. gain:				
Cottonseed meal (lbs.)	—	26.17	—	—
Corn (lbs.)	—	—	33.59	—
Oats (lbs.)	—	—	2.20	—
Wheat bran (lbs.)	—	—	16.85	—
Dressing percent (cold wt).	49.09	47.88	49.24	—
Slaughter grade	Low choice	Low choice	Low choice	—
Selling price per cwt. ($)	17.38	17.13	17.33	—
1929	Lot 1	Lot 2	Lot 3	Lot 4
Length of test (days)	66	66	66	66
Number of lambs	12	12	12	12
Age at slaughter (days)	160	153	162	162
Average initial weight (lbs.)	42.5	39.58	42.15	42.08
Average final weight (lbs.)	71.67	72.67	77.38	76.25
Average gain (lbs.)	29.17	33.08	35.23	34.17
Average daily gain (lbs.)	.44	.50	.53	.52
Feed per cwt. gain:				
Cottonseed meal (lbs.)	—	14.54	—	—
Corn (lbs.)	—	—	21.56	53.30
Oats (lbs.)	—	—	8.56	133.20
Wheat bran (lbs.)	—	—	8.56	—
Dressing percent	46.77	46.42	50.17	50.30
Slaughter grade	Low choice	Low choice	Low choice	—
Selling price per cwt. ($)	14.50	14.50	14.74	14.65
1930	Lot 1	Lot 2	Lot 3	Lot 4
Length of test (days)	68	68	68	—
Number of lambs	15	15	15	—
Age at slaughter (days)	165	162	164	—
Average initial weight (lbs.)	44.47	44.47	44.40	—
Average final weight (lbs.)	74.53	77.60	73.20	—
Average gain (lbs.)	30.07	33.13	28.80	—
Average daily gain (lbs.)	.442	.487	.423	—
Feed per cwt. gain:				
Cottonseed meal (lbs.)	—	3.63	—	—
Corn (lbs.)	—	—	10.63	—
Oats (lbs.)	—	—	1.84	—
Wheat bran (lbs.)	—	—	1.15	—
Dressing percent	47.18	48.32	47.59	—
Slaughter grade	Low choice	Low choice	Low choice	Low choice
Selling price per cwt. ($)	12.29	12.24	12.14	—

1931	Lot 1	Lot 2	Lot 3	Lot 4
Length of test (days)	51	51	51	51
Number of lambs	10	10	10	20
Age at slaughter (days)	130	128	128	128
Average initial weight (lbs.)	42.40	44.00	43.90	44.05
Average final weight (lbs.)	69.50	70.90	70.50	68.60
Average gain (lbs.)	27.10	26.99	26.60	24.55
Average daily gain (lbs.)	.530	.530	.520	.480
Feed per cwt. gain:				
Cottonseed meal (lbs.)	—	32.04	—	50.77
Corn (lbs.)	—	—	27.52	152.31
Oats (lbs.)	—	—	27.52	—
Wheat bran (lbs.)	—	—	27.52	—
Dressing percent	48.42	49.54	49.93	50.69
Slaughter grade	Low choice	Low choice	Low choice	—
Selling price per cwt. ($)	8.73	9.57	9.00	9.28

Table 2. Summary of 1928-29-30-31 tests.

	Lot 1	Lot 2	Lot 3	Lot 4
Average length of test (days)	62	62	62	58.5
Number of lambs, total 4 tests	57	57	57	32
Age at slaughter (days)	155	150	154	145
Average initial weight (lbs.)	41.92	41.62	42.24	43.07
Average final weight (lbs.)	71.75	72.64	72.86	72.43
Average gain (lbs.)	29.83	31.02	30.62	29.36
Average daily gain (lbs.)	.482	.500	.493	.500
Feed per cwt. gain:				
Cottonseed meal (lbs.)	—	19.10	—	52.04
Corn (lbs.)	—	—	23.33	142.76
Oats (lbs.)	—	—	10.04	—
Wheat bran (lbs.)	—	—	13.53	—
Feed cost per cwt. gain ($)	—	.29	.73	2.95
Dressing percent	47.87	48.04	49.23	50.50
Slaughter grade	Low choice	Low choice	Low choice	Low choice
Selling price per cwt. ($)	13.25	13.36	13.30	—
Value of lamb ($)	9.51	9.70	9.69	—
Value of lamb above cost of feed	9.51	9.61	9.47	—

Cost of feeds:

Corn, 85 cents per bu.	Wheat bran, $30.00 per ton
Oats, 56 cents per bu.	Cottonseed Meal, $30.00 per ton

in their digestive tracts for the higher quality clover forage. This could have resulted in a decrease in the milk production of the ewes.

Prices Used

In studying the prices used, one notes quite a difference in the selling price per hundred pounds from year to year. This difference in price from year to year was due to the actual difference in market value of the lamb rather than to any difference in the finish or quality of the lambs. The lambs were graded as slaughter lambs each year and the average for all lambs each year was "low choice." They varied less than one-third of a market grade.

SUMMARY

I. The average for the 4 tests as given in the summary table show:

A. That while there was no significant difference in the rate of gain, market grade, or price per hundred weight, the lambs creep-fed cottonseed meal did gain slightly faster, graded higher as slaughter lambs, and sold for slightly more per hundred weight.

B. The dressing percents were 47.87, 48.04, 49.23, and 50.50, for lots 1 through 4, respectively.

Table 3. Influence of pastures used in production of lambs.
Summary of 1928-29-30-31 tests.

Year	Lot	Daily gain	Dressing percent	Slaughter grade	Market value	Feed per cwt. gain			
						Corn	Oats	W. bran	C.S. meal
			Center east pasture, 109 acres						
1928	1	.514	49.09	1.83	17.38	—	—	—	—
1929	3	.530	50.17	1.74	14.74	21.56	8.58	8.58	—
1930	2	.487	48.33	1.49	12.24	—	—	—	3.63
Av.	—	.510	49.20	1.69	14.79	—	—	—	—
			Woods pasture, 40 acres						
1928	3	.498	49.24	1.88	17.33	33.59	2.20	16.85	—
1929	2	.500	46.42	1.88	14.50	—	—	—	14.54
1930	1	.442	47.18	1.47	12.29	—	—	—	—
Av.	—	.480	47.61	1.74	14.71	—	—	—	—
			West woods pasture, 90 acres (1/3 wooded)						
1928	2	.484	47.88	2.00	17.13	—	—	—	26.17
1929	1	.440	46.77	1.83	14.50	—	—	—	—
1930	3	.423	47.59	1.60	12.14	10.63	1.84	1.15	—
Av.	—	.449	47.41	1.81	14.59	—	—	—	—
			Rotation of pastures						
1931	1	.530	48.42	2.07	8.73	—	—	—	—
1931	2	.530	49.54	1.53	9.57	—	—	—	32.04
1931	3	.520	49.93	1.90	9.00	27.52	27.52	27.52	—
Av.	—	.527	49.30	1.83	9.10	—	—	—	—

C. The return per lamb above cost of feed, pasture not included, was greatest for the lambs creep-fed cottonseed meal while with their dams on good pasture. The lambs receiving no feed in addition to their dams' milk and pasture were second, and the lambs receiving a mixture of corn, oats, and wheat bran in addition to their dams' milk and pasture was third.

D. The value of lambs above the cost of feed for the lambs in lot 4 is not shown. These lambs were produced only two years and their average price would include one low and one high year, whereas, the other two groups included three years of high prices and only one year of low prices. While the lambs produced in this lot gained as rapidly as the lambs creep-fed cottonseed meal and had a higher dressing percent than the other three lots, the high feed cost per hundred pounds of gain would make them the least profitable group.

II. That the quality of pastures surpassed the influence of supplemental feeding is shown by the fact that:

A. Though an abundance of grazing material was available in all pastures, the average rate of gain, dressing percent, market grade, and value per hundred weight for the three years was highest for the groups in the superior center east pasture and least for those in the inferior west woods pasture.

B. Regardless of how the lambs were handled, the rate of gain was greatest for the group in the center east pasture and least for the group in the west woods pasture.

C. When the group was rotated every two weeks the difference between the groups was not significant, although the rate of gain, dressing percent, and market value favored the cottonseed meal fed lambs.

III. Quality and palatability of lambs.

A. The market grade of lambs on foot and in the carcass, and the palatability of the cooked meat of lambs slaughtered at aproximately 4 to 5 months of age, was influenced relatively little by grain feed as a supplement on good to choice pasture while lambs were suckling their dams.

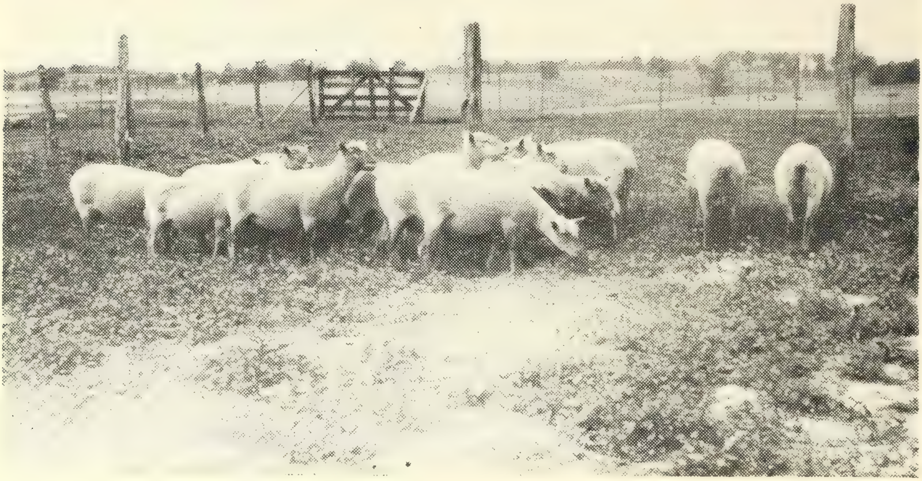

Figure 2. High grade Southdown ewes used in this study.

PART II

Influence of Type and Breeding In Spring Lamb Production

How much can I pay for a purebred ram and can I afford to save ewe lambs for replacement purposes in order to grade-up an improved flock on my farm? These questions are foremost in the minds of most progressive sheep men.

The results of many demonstrations indicate the possibility of improving farm flocks through the use of purebred rams of some recommended breed and the replacement of old ewes with their grade daughters. Many practical farmers have felt for some time that the relative high value of grade lambs at market time, as compared to the low cost of native ewes, favored the buying of native ewes for flock replacement. Parasites, which in the past claimed many lambs during the first summer of their lives, and the delay of one year in breeding ewe lambs, makes this means of securing flock replacements a rather unpopular one.

While the grading-up method has its disadvantages, it does enable one to improve the type and breeding of his flock through the use of good purebred rams and offers a means of selecting early-maturing ewes of desirable type from early yeaning, heavy milking, twin-bearing dams.

The purpose of this study was to determine the influence of type and of breeding. The following groups were used:

Lot 1, native ewes bred to native rams.

Lot 2, native ewes bred to Southdown rams.

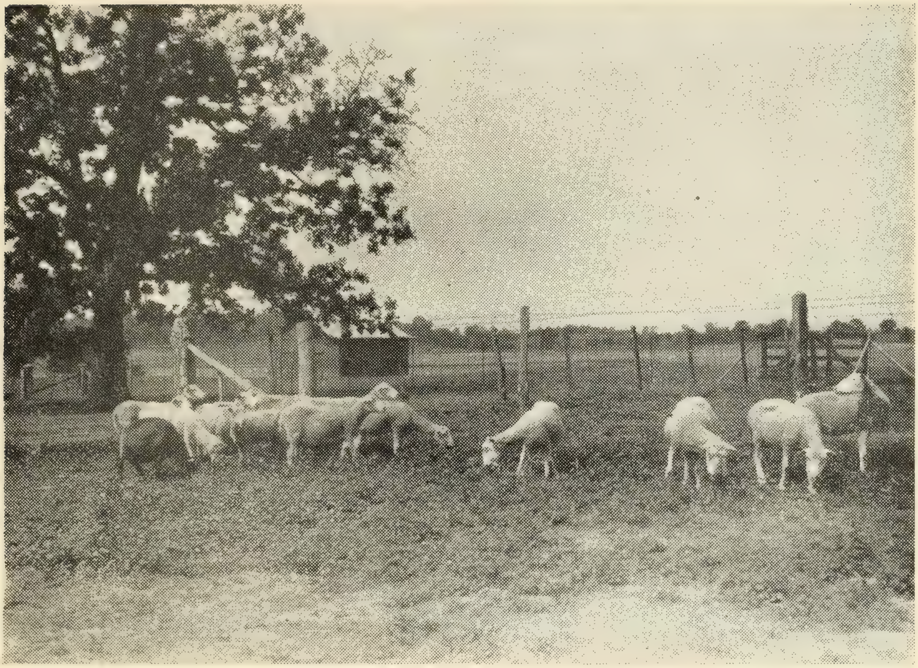

Figure 3. Native ewes used in this study.

Lot 3, high grade Southdown ewes bred to Southdown rams.

Description of Ewes

The native sheep used in this study were those common to the Coastal Plains area of this state. They were long of leg, with long narrow heads and necks, long narrow shallow bodies, with long thinly fleshed thighs. Wool of half-blood grade covered the body with the exception of the head, legs, and belly. These portions of the body were covered with coarse white hair. The grade Southdown ewes carried three or more crosses of Southdown breeding out of a native foundation flock. The Southdown rams were of present day type, being deep, broad, low-set, compact throughout, straight lined, thickly fleshed.

Methods Used in Test

The ewes were pasture bred to produce their lambs in December, January, and February. Their summer and fall management was the same as described for the ewes in Part I of this bulletin. The lambs were yeaned in December, January, and February. They were pastured with their dams on oat pasture until approximately April 1, when they were moved to permanent pasture. Previous to lambing and while in winter quarters the ewes were fed a daily ration of 1 1/3 pounds Johnson grass hay and 1/2 pound cottonseed meal. After lambing and until the flock was moved to permanent pasture, the ewes and lambs were pastured on winter oats and the ewes were fed 3/4 pound of Johnson grass hay and 1/2 pound of cottonseed meal daily. No feed in addition to pasture was fed to either the ewes or lambs once they were moved to permanent pasture, as previous tests at this Station showed conclusively that the rate of gain, grade of lamb, and palatability of the meat of lambs slaughtered at 4 to 5 months of age, were influenced relatively little by grain fed as a supplement on good to choice pasture while the lambs were suckling their dams. Pasture used during this period was the same as described in Part I of this bulletin.

The birth weight of the lambs was used as the initial weight, and the average of three weights taken on successive days at the conclusion of the test was used as the final weights for these lambs. The lambs were graded as slaughter lambs. Half of the lambs were sold on the National Stock Yards Illinois market. The remaining half of the lambs in each lot were slaughtered and information secured as to the grade of carcass, dressing percent, cut-out yields, and plumpness of leg. The right leg of the lambs were cooked by a standard method and information secured as to cooking losses and as to palatability of the cooked meat. The cooking was done under the supervision of the Home Economics Department of the Mississippi Experiment Station.

Results as to number of lambs, length of test or age of lambs at time of slaughter, initial and final liveweight, daily

Table 4. The influence of type and breeding in spring lamb production: 1932-33-34.

	Native lambs	First-cross Southdown lambs	High grade lambs
1932	Lot 1	Lot 2	Lot 3
Number of lambs	14	15	15
Length of test (days)*	132	127	130
Average initial weight of lambs (lbs.)**	6.43	7.17	7.23
Average final weight of lambs (lbs.)	69.12	72.64	75.57
Average gain per lamb (lbs.)	62.69	65.47	68.34
Average daily gain per lamb (lbs.)	.475	.516	.526
Average market grade of lamb	Medium	Good	Choice

*From birth to final weight previous to slaughter.

**Birth weight.

1933	Lot 1	Lot 2	Lot 3
Number of lambs	10	10	15
Length of tests (days)*	130	122	113
Average initial weight (lbs.)**	7.4	7.65	8.0
Average final weight (lbs.)	73.7	75.3	78.2
Average gain (lbs.)	66.3	67.65	70.2
Average daily gain (lbs.)	.510	.555	.621
Selling price*** ($)	5.25	7.50	7.75
Average market grade of lamb	Medium	Good	Choice

*From birth to final weight previous to slaughter.

**Birth weight.

***A group of lambs were sold on the National Stock Yards May 22, 1933.

1934	Lot 1	Lot 2	Lot 3
Number of lambs	10	10	10
Length of tests (days)*	142.7	141.1	143.0
Average initial weight (lbs.)**	8.8	9.75	9.0
Average final weight (lbs.)	73.4	70.6	75.0
Average gain (lbs.)	64.6	60.85	64.0
Average daily gain (lbs.)	.453	.431	.447
Selling price*** ($)	7.68	10.25	10.50
Average market grade of lamb	Medium	Good	Choice

*From birth to final weight previous to slaughter.

**Birth weight.

***A group of lambs were sold on the National Stock Yards May 28, 1934.

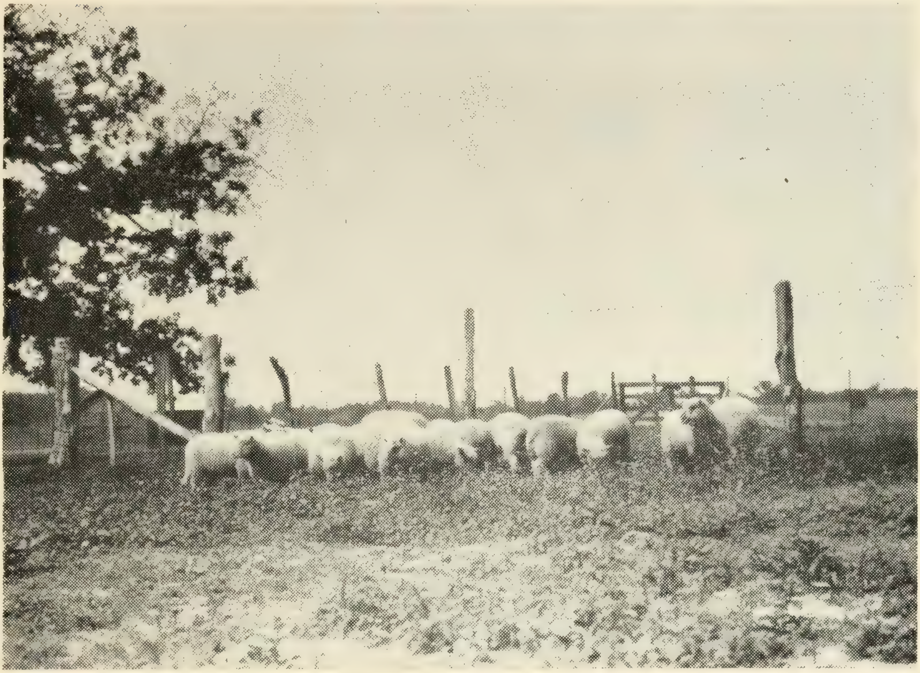

Figure 4. Lambs from high-grade Southdown ewes by Southdown rams.

Table 5. The influence of type and breeding in spring lamb production.
Average of 1932, 1933, and 1934 results.

	Lot 1	Lot 2	Lot 3
Number of lambs, all tests	34	35	40
Average length of tests (days)*	135	130	129
Average initial weight (lbs.)**	7.55	8.19	8.08
Average final weight (lbs.)	72.07	72.85	76.43
Average gain (lbs.)	64.52	64.66	68.35
Average daily gain (lbs.)	.478	.497	.530
Market value*** ($)	9.92	11.31	12.34
Average percent lamb crop	116	116	119
Average wool clip (lbs.)	4.6	4.6	5.5
Average value of wool per pound (cents)	35	35	35

*From birth to final weight previous to slaughter

**Birth weight.

***Marked value according to grade as B.A. E. U.S.D.A. report of National Stock Yards Illinois marked on day sold. Average of years 1927 through 1934.

Grading of lambs and carcasses

	Lot 1	Lot 2	Lot 3
Grade of lamb	22.80 (medium)	15.15 (good)	9.69 (choice)
Grade of carcass	23.25 (medium)	15.25 (good)	8.71 (choice)
Length of body	4.50 (long)	3.09 (mod. short)	2.15 (short)
Length of carcass	4.78 (long)	2.94 (mod. short)	2.33 (short)
Color of fat	2.73 (slightly yellow)	1.98 (white)	1.58 (white)
Weight of pelt	3.83 (slightly heavy)	3.05 (mod. light)	2.45 (light)

gain, market grade and value of lambs are shown in tables 4 and 5. Table 6 includes a summary of the information on the slaughtering and cooking studies.

DISCUSSION OF RESULTS

In studying the results of this test, one must keep in mind that no special attention was given to the selection of ewes for twinning, date of yeaning, rate of gain, milking qualities, or wool production. The only thought in selecting the ewes for this study was to secure natives showing no indication of improved breeding and to secure grade Southdown ewes of desirable mutton type. Twinning, milk production, date of yeaning

Table 6. Carcass yields of cooking and palatability studies; average of 1932-34 results.
Average dressing percent, cutting yield, weight of head, caul fat, and pelt.

	Lot 1		Lot 2		Lot 3	
	Weight	Percent	Weight	Percent	Weight	Percent
Weight at slaughter*	69.90	—	69.80	—	71.83	—
Weight of hot carcass	37.01	—	37.63	—	40.27	—
Weight of cold carcass	35.53	—	36.47	—	38.34	—
Dressing percent (cold carcass)**	—	50.83	—	52.25	—	53.38
Weight of head	2.21	4.59	3.32	4.78	3.29	5.03
Weight of caul fat	1.21	1.74	1.36	1.95	1.43	1.99
Weight of pelt (unshorn)	6.95	9.93	7.07	10.14	6.88	9.59
Legs, trimmed	10.92	30.72	10.91	29.92	11.49	27.01
Legs, untrimmed	12.54	35.40	12.48	34.04	13.04	33.51
Shoulder	8.50	23.99	8.64	23.57	8.94	22.97
Loin	3.24	9.15	3.66	10.00	4.14	10.64
Neck	1.30	3.67	1.21	3.30	1.16	2.98
Ribs	4.13	11.66	4.57	12.46	5.10	13.11
Breast	4.59	12.98	5.01	13.66	5.43	13.96
Kidneys	.22	.62	.22	.60	.22	.57
Kidney fat	.90	2.51	.87	2.37	.88	2.26
Leg, loin, and rib	19.90	56.18	20.72	56.52	22.29	57.26

*Weight secured after a 24 hour fast from food.

**Based on slaughter weight or after fast period.

	Lot 1	Lot 2	Lot 3
Plumpness of leg			
Right leg, (percent)	90.19	112.96	126.30
Left leg (percent)	90.99	112.78	125.04
Cooking data			
Losses from evaporation (percent)	10.21	9.98	10.19
Losses from drippings (percent)	5.71	7.23	7.99
Total losses from evaporation and drippings (percent)	15.92	17.21	18.18

Palatability

	Lot 1	Lot 2	Lot 3
	Grade interpretation	Grade interpretation	Grade interpretation
Intensity			
Aroma	4.66 Mod. pronounced	4.66 Mod. pronounced	4.66 Mod. pronounced
Texture	5.00 Mod. fine	5.00 Mod. fine	5.00 Mod. fine
Flavor of fat	3.66 Slightly pron.	4.00 Slightly pron.	3.66 Slightly pron.
Flavor of lean	4.66 Mod.pronounced	4.66 Mod. pronounced	5.00 Mod. pronounced
Tenderness	5.00 Mod. tender	5.00 Mod. tender	5.66 Tender
Juiciness			
Quality	4.33 Slightly rich	4.66 Mod. rich	4.66 Mod. rich
Quantity	5.00 Mod. juicy	5.00 Mod. juicy	5.00 Mod. juicy
Desirability			
Aroma	5.00 Mod. desirable	5.00 Mod. desirable	5.00 Mod. desirable
Flavor of fat	4.33 Slightly desirable	4.33 Slightly desirable	4.66 Mod. desirable
Flavor of lean	5.00 Mod. desirable	5.00 Mod. desirable	5.66 Desirable

Figure 5. Lambs from Native ewes by Southdown rams.

and other desirable characteristics can surely be influenced by selecting replacement ewes from dams having these desirable qualities. Twin lambs were considered in determining the percent lamb crop produced by these three groups. There was no uniformity as to number of twin lambs in each lot and for that reason they were not considered in the comparisons shown in tables 4 and 5.

The prices used in 1933 and 1934 were the actual prices paid by the packer buyer on the National Stock Yards Illinois market for half of the lambs marketed from each of the three groups during those years. No prices were secured for 1935. The price used in table 5, showing the average for the three tests, is the average price per hundred weight according to the market grade of lamb as given by the report of the Bureau of Agricultural Economics, Livestock Division, for the last Monday in May for the years 1927 through 1934 covering lambs sold on the National Stock Yards Illinois market. Prices for choice lambs were as low as $7.75 per hundred weight and as high as $18.00 per hundred weight during this period. The price for wool cited in table 5 was the average price paid for wool during the same years. Prices varied from as low as 23 cents per pound to as high as 50 cents per pound.

SUMMARY

1. The high grade Southdown lambs though slightly lighter than the first-cross lambs at birth, gained more rapidly and were heaviest at weaning time.
2. The high grade lambs graded "choice", as compared to "good" for the first cross lambs, and "medium" for the native lambs. The high grade lambs brought $1.04 more per hundred pounds live weight than the first-cross lambs,

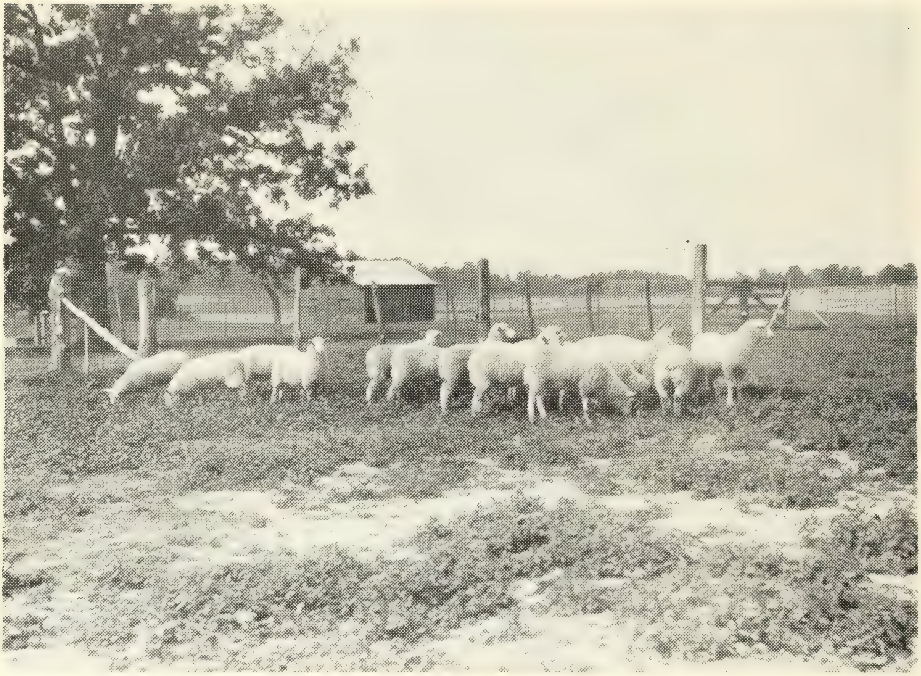

Figure 6. Lambs from Native ewes by Native rams.

and $2.42 per hundred pounds more than the native lambs.

3. The grade ewes produced an average of 119 lambs per 100 ewes, as compared to 116 lambs per 100 ewes for the native ewes.

4. The grade ewes produced an average of 5.5 pounds of half-blood wool as compared to 4.6 pounds for the native ewes.

5. The range in dressing percent was from 53.33 for the high grade lambs, 52.10 percent for the Southdown natives, and 50.84 percent for the native lambs.

6. The carcass grades were "medium" for the native, "good" for the Southdown natives, and "choice" for the high-grade Southdown lambs. The length of carcass becomes shorter, the color of fat brighter, and the weight of pelt lighter as the lambs approach ideal mutton type and breeding.

7. The percent of leg, loin, and rib, (the three most valuable cuts of the lamb carcass) and the plumpness of leg, were greatest for the lambs of improved type and breeding.

8. The total cooking losses from evaporation and drippings was greatest for the higher conditioned high-grade lambs and least for the thinner native lambs.

9. The results of the palatability study shows that the high-grade lambs had a slight advantage in tenderness of the cooked meat, quality of juiciness, and flavor of fat and lean.

10. In essential respects the high-grade ewes were superior for lamb and wool production to native ewes, and native ewes bred to registered rams were superior to native ewes bred to native rams.

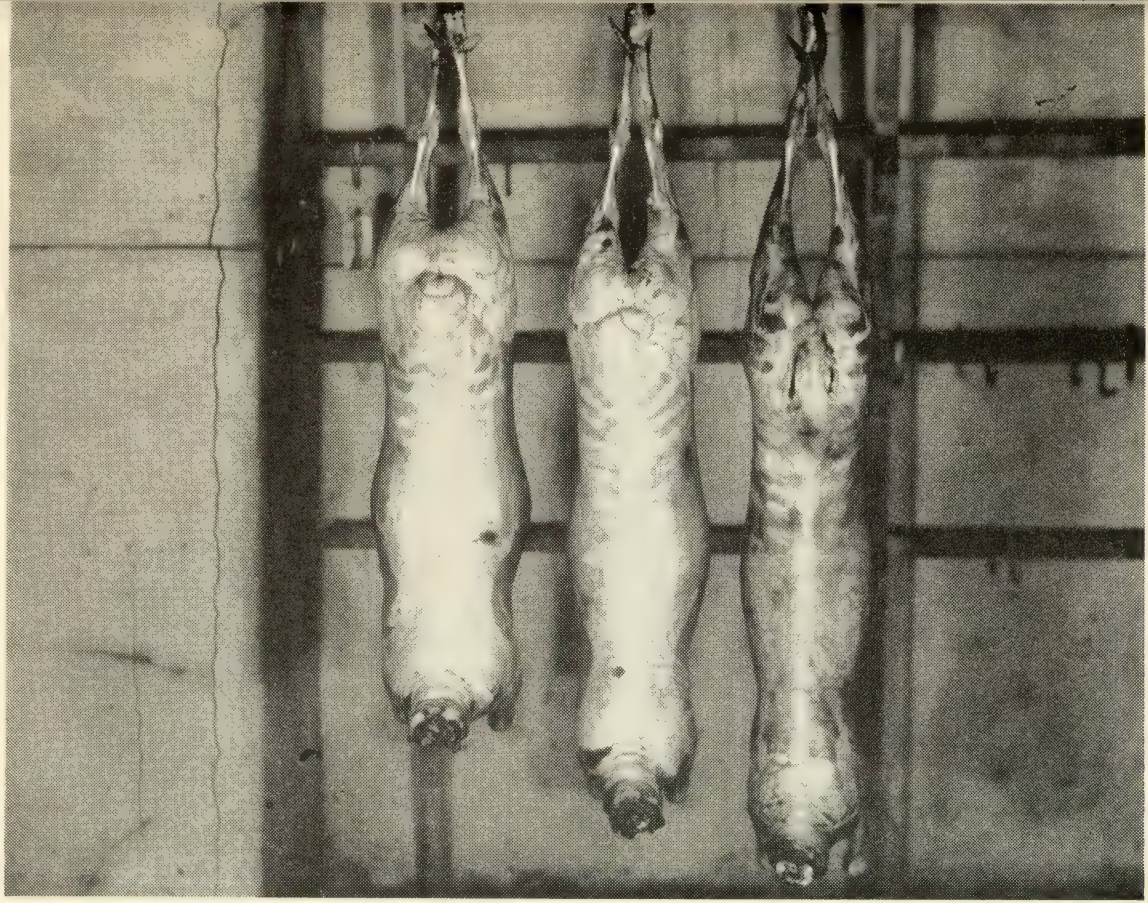

Figure 7. Carcasses of a high grade Southdown lamb, a first-cross lamb out of a Native ewe by a Southdown ram, and a Native lamb produced in this study during 1932. Note the thicker fleshing, the compactness, the fullness of leg, and the width throughout the top of the high grade lamb on the left. This thick covering, compactness, and width through the leg, loin, and rib, influences the dressing percent and percent of valuable cuts in favor of the better bred lamb.

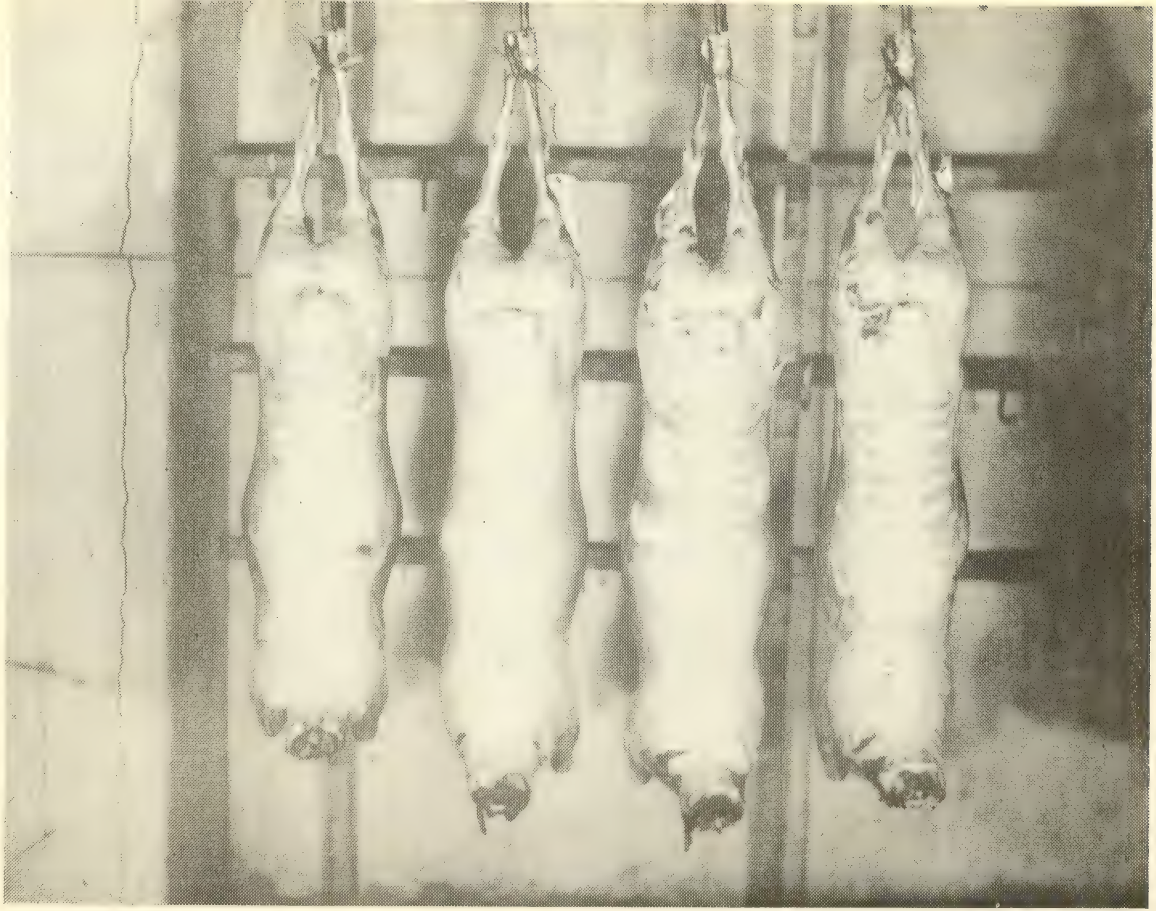

Figure 8. Four carcasses produced out of high-grade Southdown ewes by Southdown rams. These lambs were yeaned in December and January and were produced without the aid of grain. They ran with their dams from birth to slaughter, approximately 140 days, on oat pasture, during the winter period, and clover pasture until slaughtered, during the latter part of May. The market grade of these carcasses and the palatability of the cooked meat of these lambs slaughtered at approximately four to five months of age, compared most favorable to carcasses produced by lambs grain fed while with their dams on good pastures.

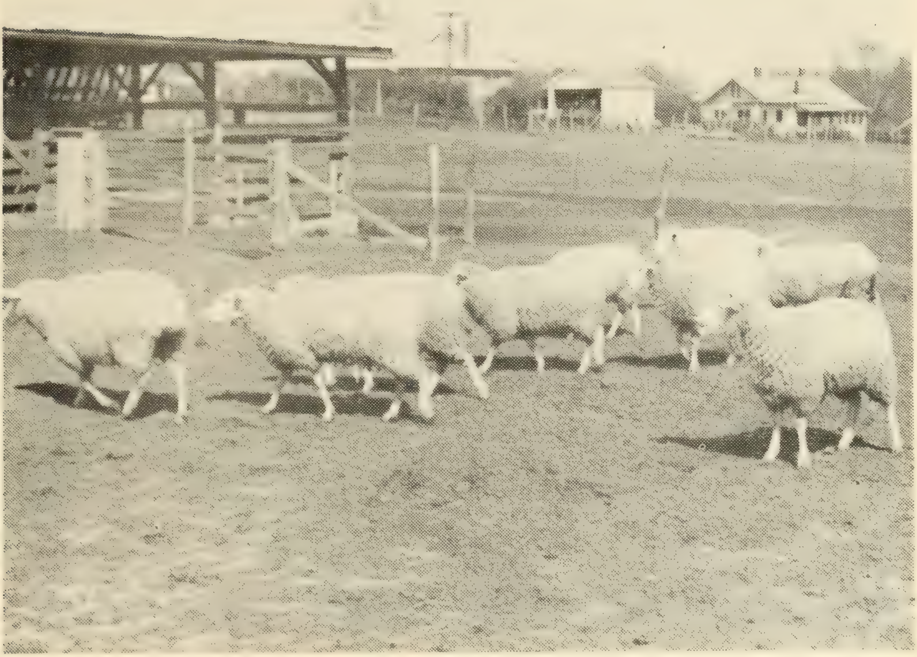

Figure 9. Yearling ewes sired by Corriedale-rams and out of Native ewes.

PART III

The Value of Corriedale, Hampshire, and Southdown Breeding In Spring Lamb and Wool Production

The high prices paid for lambs marketed in April and May (the returns from an 80-pound lamb will usually purchase a replacement yearling ewe), coupled with the "trouble" of raising ewe lambs to replacement age, has caused many of our flock owners to adopt a system of selling all lambs produced and of purchasing their flock replacements. Tests conducted locally indicate that unless specially desirable breeds are used, and unless care is taken to select early yeaned, rapid maturing ewe lambs from heavy milking, twin-bearing dams, this practice is probably a desirable one. Usually the ideal lamb to keep for flock replacement is the lamb most likely to top the market at weaning time. When such lambs are sold, and the small, slow-gaining, late-yeaned lambs that have little market value are maintained for flock replacement, the breeding efficiency of the flock is sure to be lowered.

The matter of securing good ewes for flock replacement is a problem in Mississippi. The only ewes generally available are the natives of the Coastal Plain area of the State. These sheep, while inferior in mutton conformation and lacking in wool covering, are very hearty and good doers if given a chance. Producers in the Coastal Plain area, in general, give their flocks very little attention. Few fat lambs are sold, and most of the income is derived from the sale of wool and the occasional sale of surplus ewes to producers in the lamb producing section of this state. The need of a breed to

Table 7. The influence of Corriedale, Hampshire, and Southdown rams in spring lamb production. Average of 3 tests, 1936-38, producing grade ewes whose performance is measured in tables 8 and 9.

	Lot 1 Native ewes; Corriedale rams	Lot 2 Native ewes; Hampshire rams	Lot 3 Native ewes; Southdown rams	Lot 4 Native ewes; Native rams
Average birth date	Jan. 10	Jan. 6	Jan. 3	Jan. 1
Average age at slaughter (days)	128	136	139	142
Average birth weight (lbs.)	8.45	9.31	9.13	8.71
Average final weight (lbs.)	69.73	70.33	66.14	67.50
Average gain (lbs.)	60.28	61.03	56.92	58.79
Average daily gain (lbs.)	.474	.450	.412	.414
Dressing percent (cold weight)	48.16	50.50	48.39	48.10
Slaughter grade	Med. plus	Good minus	Good minus	Medium
Carcass grade	Medium	Good minus	Good minus	Medium

improve the mutton and wool qualities of these native ewes prompted this study.

Methods Used in Test

The objective of this study was to study the influence of Corriedale, Hampshire, and Southdown breeding in spring lamb and wool production.

A group of yearling and 2-year-old native ewes were purchased from South Mississippi. They were typical "natives," being the long legged, narrow shallow bodied type, with a covering of white hair over the face, legs, and belly. They were divided uniformly as to age and size, and were bred to representative rams of the Corriedale, Hampshire, and Southdown breeds. One group of ewes was bred to a native ram.

The ewe lambs produced by the above crosses were graded as slaughter lambs at weaning time. They were retained and bred to Southdown rams to determine their relative value in wool and spring lamb production. The wether lambs produced by these crosses were graded and sold as fat lambs at weaning time.

Table 7 gives the information as to birth weight, final weight, rate of gain, dressing percent, and market value of these first-cross lambs out of native ewes by the Corriedale, Hampshire, Southdown and native rams.

The first-cross and native ewes produced for this study were handled as one group. They were bred first as yearlings to Southdown rams of present day type. The ewes were handled during the breeding and summer pasture season in the same manner as reported in Part I of this bulletin, with the exception that no treatment for parasites was given to the ewes or lambs during the period of these tests.

The ewes yeaned during December, January, and February. Prior to yeaning the ewes received a ration of 1 1/3 pounds Johnson grass hay and 1/2 pound of cottonseed meal daily. With the exception of the winter period for 1938-39, and 1939-40, the ewes and lambs were pastured on oats pasture, and the ewes were fed 3/4 pounds of lespedeza hay and 1/2 pound of oats daily. Due to the very dry fall of 1938 no winter pasture was available, and winter pasture was very limited during the winter 1939-40. During these winter periods the ewes received a ration of ground corn, cottonseed meal, sorghum silage, and lespedeza hay.

The ewes and lambs were moved to permanent pasture about March 20, where they remained until the lambs were weaned for market. Yellow hop clover represented approximately 75 percent of the permanent pasture forage; however, small amounts of wild barley, bur clover, white clover, Kentucky blue grass, Bermuda grass, and dallis grass, were available. Neither the ewes nor the lambs received

Figure 10. Yearling ewes sired by Hampshire rams and out of Native ewes.

any feed in addition to pasture during this period, as previous tests showed conclusively that the rate of gain, grade of lamb, and palatability of meat of lambs slaughtered at approximately 4 to 5 months of age, were influenced relatively little by grain fed as a supplement on good to choice pasture while the lambs were suckling their dams.

Birth weights were used as the initial weight and the average of 3 weights taken on consecutive days at weaning time were used as final weights.

The ewes were clipped the second week in April and records kept as to the amount of wool produced. The results of the 3 tests completed on this project are shown in table 8. Table 9 gives an average of the 3 tests completed, and the average wool clip from the grade ewes as yearling, two-year old, and three-year old ewes.

DISCUSSION OF RESULTS

A study of table 7 shows the influence of Corriedale, Hampshire, and Southdown rams on the lambs produced out of native ewes. While there was relatively little difference in rate of gain of lambs from birth to weaning, the gain did favor the lambs sired by Corriedale and Hampshire rams. The dressing percent for the wethers slaughtered favored the lambs produced by the Southdown and Hampshire rams. The slightly higher dressing percent of native wethers over the wethers by the Corriedale rams can be explained by the heavier pelts of the Corriedale-native wethers.

The lambs by the Southdown and Hampshire rams graded one-third of a market grade higher than the lambs by the Corriedale rams and two-thirds grade higher than those sired by the native ram. The carcasses of the wether lambs sired by the Southdown and Hampshire

Table 8. The influence of Corriedale, Hampshire and Southdown rams in spring lamb production: 1939-41.

	Lot 1 Corriedale-Native ewes; Southdown rams	Lot 2 Hampshire-Native-ewes; Southdown rams	Lot 3 Southdown-Native ewes; Southdown rams
1939			
Average birth date	Dec. 26	Jan. 10	Jan. 9
Average age at slaughter (days)	165	140	141
Average birth weight (lbs.)	9.7	9.6	9.6
Average final weight (lbs.)	77.5	67.0	62.8
Average gain (lbs.)	67.8	57.4	53.2
Average daily gain (lbs.)	.411	.410	.378
Average slaughter grade	Good plus	Good plus	Good plus
1940			
Average birth date	Dec. 24	Jan. 2	Jan. 15
Average age at slaughter (days)	142	141	131
Average birth weight (lbs.)	9.5	9.4	9.3
Average final weight (lbs.)	68.2	66.4	62.4
Average gain (lbs.)	58.7	56.6	53.1
Average daily gain (lbs.)	.413	.401	.41
Average slaughter grade	Good plus	Good plus	Good plus
1941			
Average birth date	Jan. 10	Jan. 22	Jan. 19
Average date at slaughter (days)	133	121	124
Average birth weight (lbs.)	9.8	9.8	8.8
Average final weight (lbs.)	74.3	75.5	68.0
Average gain (lbs.)	64.5	65.7	59.2
Average daily gain (lbs.)	.49	.54	.48
Average slaughter grade	Good plus	Good plus	Good plus

Table 9. The influence of Corriedale, Hampshire and Southdown rams in spring lamb production. Average 1939-1940-1941

Average birth date	Dec. 27	Jan. 11	Jan. 24
Average age at slaughter (days)	147	135	132
Average birth weight (lbs.)	9.7	9.6	9.2
Average final weight (lbs.)	73.3	69.5	64.4
Average gain (lbs.)	63.6	59.9	55.2
Average daily gain (lbs.)	.433	.444	.418
Average slaughter grade	Good plus	Good plus	Good plus
Wool yields from first-cross ewes			
	Yearling	2-year-old	3-year-old
Corriedale-Native	8.87	6.90	6.70
Hampshire-Native	7.25	5.20	4.90
Southdown-Native	6.53	4.87	4.70

rams graded two-thirds of a market grade higher than the lambs by the Corriedale or native rams.

Table 8 give the results of the 1939, 1940, and 1941 tests wherein the first-class Corriedale-native, Hampshire-native and Southdown-native ewes produced in the tests reported in table 7 were bred to Southdown rams to determine their relative value in wool and in spring lamb production. The average of these three tests is given in table 9.

A study of this table shows that the Corriedale-native ewes lambed 19 days earlier than the Hamphire-native ewes and 28 days earlier than the Southdown-native ewes, with relatively no difference in the daily gain of the lambs out of these first-cross ewes. This earliness of lambing resulted in the lambs out of the Corriedale-native ewes being approximately four pounds heavier at market time than those out of Hampshire-native ewes and approximately nine pounds heavier than

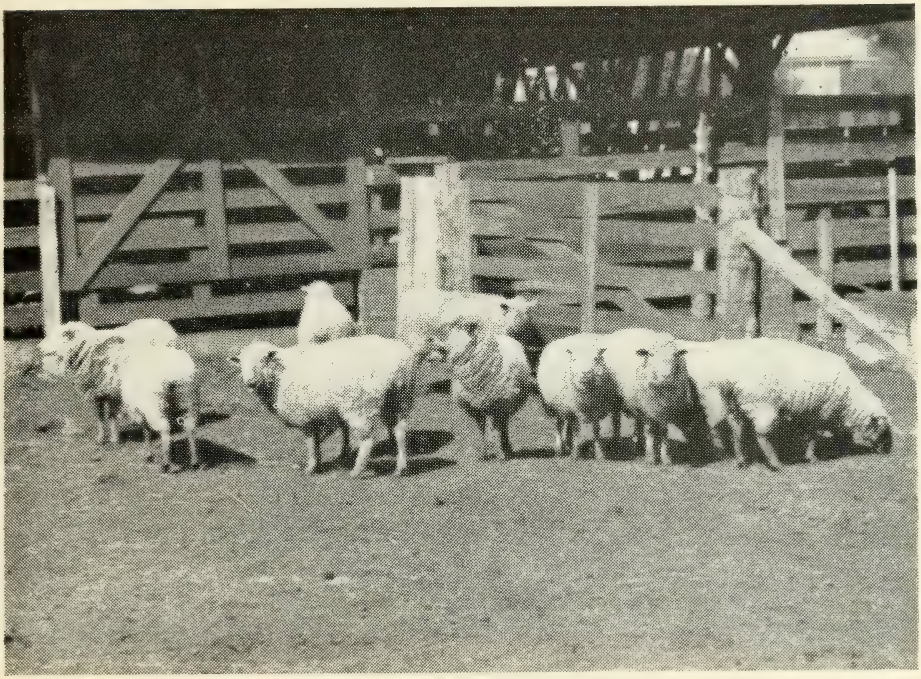

Figure 11. Yearling ewes sired by Southdown rams and out of Native ewes.

the lambs out of the Southdown-native ewes.

The average rate of gain for the three tests are low in all lots. This was due, at least partially, to the large amount of dry lot feeding required during the first two tests. Insufficient winter pasture was available for the ewes and lambs during these tests. The lambs out of these ewes averaged "good-plus" as slaughter lambs. This grade has been sufficiently high to sell within 50 cents per hundred of the prices paid for market lambs sold prior to June 1 during the years 1927-1941.

Table 9 shows the average weight of wool produced by these grade ewes as yearling, two-, and three-year-old ewes This table shows the Corriedale-native ewes led in wool production as yearling two- and three-year-old ewes. They averaged 7.49 pounds of wool for the three years, as compared to 5.78 pounds for the Hampshire-native ewes and 5.38 pounds for the Southdown-native ewes.

SUMMARY

1. The lambs from each group of ewes, when sired by Southdown rams, averaged "good-plus" as market lambs.
2. The average birth weight and rate of gain of the lambs slightly favored the Corriedale and Hampshire grade ewes. The difference was insignificant.
3. The Corriedale-native ewes yeaning 19 days earlier than the Hampshire-native and 28 days earlier than the Southdown-native ewes, resulted in heavier lambs at a fixed market date.
4. The Corriedale-native ewes averaged 1.71 pounds more wool each year as yearling, two-, and three-year-old ewes than the Hampshire-native ewes, and 2.11 pounds more wool than the Southdown-native ewes.

Figure 12. Montana ewes used in this study, pictured as yearlings.

PART IV

Northwestern, Southwestern, and Corriedale-Native Ewes In Lamb and Wool Production*

Recent trends in securing replacement ewes for our farm flocks have been toward buying ewes from the northwestern or southwestern states, rather than buying native ewes from the coastal plain section of Mississippi. The western ewes are largely out of grade Rambouillet ewes and sired by rams of Hampshire, Corriedale, or other mutton-type breeds. They are superior to our coastal plain sheep, being deeper, broader, and more compact of body, shorter necked and legged, and heavier fleshed. They are larger, weighing from 130 to 140 pounds at maturity, and produce a heavier wool clip. Coming from the range section, they are reasonably free from internal parasites. Since they are of a fine wool foundation, they tend to breed in time to lamb in December, January, and February.

The test reported in part three of this bulletin indicates the high value of Corriedale breeding for improving the value of our native flocks in wool yields and as replacement ewes for flocks used to produce spring lambs. A number of rams of this breed have been used in the southern section of Mississippi and seem well adapted to that area.

With this information in mind this test was conducted to determine the relative value of Northwestern, Southwestern, and Corriedale-native ewes in wool and lamb production.

Sources of Ewes

A group of native ewes was purchased from south Mississippi, bred to Corriedale rams, and the ewe lambs kept to

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*The first two years of this experiment was conducted by Ray H. Means.

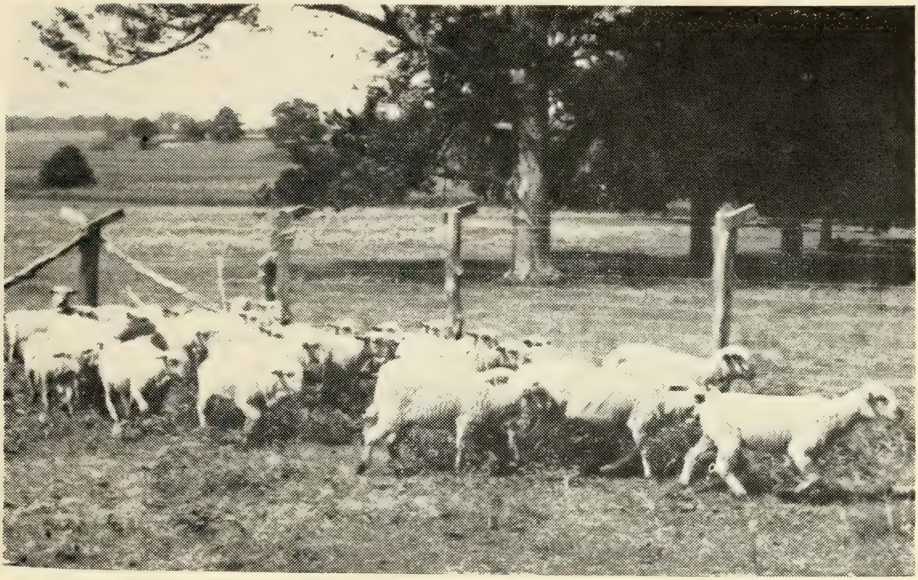


Figure 13. Texas ewes used in this study, pictured as yearlings.

compare with ewes purchased from Montana and from Texas. The ewes from Montana were largely Rambouillet and Hampshire crosses, whereas the ewes from Texas were of Rambouillet with evidences of Hampshire and Southdown breeding. Both groups of western ewes reached the Mississippi Station the middle of July, 1942.

Methods Used in Test

Southdown rams were placed in the pasture with these ewes and remained with them until October 15. The Corriedale-native ewes were not available until the 1943 breeding season. During the 1944, 1945, and 1946 tests the three groups of ewes were handled as one flock. They were pasture bred to Southdown rams to lamb in December, January, and February.

During the breeding season and until approximately December 1 they were handled as were the ewes reported in part three of this bulletin. From December 1 to March 15 the ewes with their lambs had the run of a temporary grazing crop of oats, and in addition the ewes were fed a daily ration of 1/2 pound of whole oats and a small amount of mixed hay (alfalfa and Johnson grass). The lambs received no feed in addition to their dams' milk and winter pasture.

The ewes with their lambs were put on permanent pasture (see description of permanent pasture as given in Part I of this bulletin) on or about March 15 each year where they remained without additional feed until the last week in May when the lambs were weaned, weighed, graded as market lambs, and sold. The ewes were clipped the week following Easter Sunday, and a record was made of the wool produced.

During the 1945 test each ewe received a drench containing 25 grams of phenothiazine when placed on pasture. The ewes and lambs had access at all times to a mixture of nine parts granulated salt and one part phenothiazine.

Information as to birth weights of the lambs, weight at slaughter, wool clip produced and other interesting data collect-

Table 10. Northwestern, Southwestern, and Corriedale-native ewes in wool and spring lamb production: 1944.

	Montana ewes	Texas ewes	Corriedale-native ewes
1944			
Number of ewes	30	29	18
Average birth date	Jan. 30	Jan. 10	Jan. 10
Average birth weight (lbs.)	9.1	9.1	8.0
Average final weight (lbs.)	69.6	68.0	67.3
Percent lamb crop weaned	100	90	100
Average weight of fleece (lbs.)	8.0	7.4	8.5
Market grade of lambs:			
Choice, percent	37	42	22
Good, percent	47	31	39
Medium, percent	16	23	33
Common, percent	—	4	6
Gross returns per ewe from wool and lamb	$13.04	$11.87	$12.61
1945			
Number of ewes	29	28	37
Average birth date	Jan. 7	Dec. 31	Dec. 24
Average birth weight (lbs.)	9.4	8.4	8.5
Average final weight (lbs.)	77.0	72.0	74.0
Percent lamb crop weaned	73	125	98
Average weight of fleece (lbs.)	7.45	6.77	6.65
Market grade of lambs:			
Choice, percent	19	20	16
Good, percent	57	41	42
Medium, percent	24	39	42
Common, percent	—	—	—
Gross returns per ewe from wool and lamb	$11.04	$15.52	$12.86
1946			
Number of ewes	28	24	34
Average birth date	Jan. 23	Jan. 12	Jan. 13
Average birth weight (lbs.)	8.7	8.7	8.6
Average final weight (lbs.)	71.8	70.9	69.4
Percent lamb crop weaned	98	117	118
Average weight of fleece (lbs.)	7.6	7.3	7.7
Market grade of lambs:			
Choice, percent	30	29	8
Good, percent	26	47	40
Medium, percent	41	18	42
Common, percent	3	6	10
Gross returns per ewe from wool and lamb	$14.27	$16.51	$15.87

Table 11. Northwestern, Southwestern, and Corriedale-Native ewes in wool and spring lamb production: Average 1944-45-46 results.

	Montana ewes	Texas ewes	Corriedale-native ewes
Average number of ewes	29	27	29
Average birth date	Jan. 20	Jan. 7	Jan. 5
Average birth weight (lbs.)	9.1	8.7	8.4
Average final weight (lbs.)	72.8	70.3	70.2
Percent lamb crop weaned	90	111	107
Average weight of fleece (lbs.)	7.7	7.2	7.6
Market grade of lambs:			
Choice, percent	29	30	15
Good, percent	43	40	41
Medium, percent	27	27	39
Common, percent	1	3	5
Gross returns per ewe from wool and lamb	$12.78	$14.63	$13.78

ed during these tests are shown in the following tables. Table 10 gives the annual results for the years 1944, 1945, and 1946, respectively. Table 11 gives an average for these three tests.

DISCUSSION OF RESULTS

Attention is called to the fact that the results of the first year's production of the Montana and Texas ewes are not shown in the above tables. They were not included because the Corriedale-native ewes were not available until the following year. Although not included in this study, a statement of the production of these western ewes during their first year in Mississippi will be of interest to those interested in buying replacement ewes.

During their first year in Mississippi, the Montana ewes averaged a 56 percent lamb crop and produced an average of 5.79 pounds of wool, as compared to a 46 percent lamb crop and 5.69 pounds of average wool clip for the Texas ewes. It is possible that this poor production record was due to the late arrival of these western ewes in Mississippi and stresses the importance of buying your ewes for early arrival should you use this method of securing ewe replacements. Yearling Corriedale-native ewes produced in Mississippi weaned a 100 percent lamb crop and produced 8.5 pounds of wool.

Attention is also called to the fact that the Corriedale-native ewes used were first-cross ewes out of South Mississippi native ewes. Should Corriedale rams be used in our range section for a period of years the percent of Corriedale breeding in our range flocks would be increased, resulting in a replacement ewe that should be superior in wool and in lamb production to the first-cross ewes used in this study.

It will be noticed that both the Corriedale-native and Texas ewes lambed earlier than did the Montana ewes. However, the faster gaining lambs from the Montana ewes were heavier at market time.

It will also be noticed that the lambs from the Montana and Texas ewes graded higher than did the lambs from the first-cross Corriedale-native ewes. A study of the pictures of these ewes will show the Montana and Texas ewes to be superior in mutton conformation and in fleshing qualities, which undoubtedly influences the market grade of their lambs.

The gross returns per ewe were based on the actual prices received for the lambs and wool when sold in cooperative lamb and wool pools. The variance in gross income per ewe from year to year was due, in a large measure, to the difference in prices paid for lamb and wool from year to year. The higher gross returns for the Texas and Corriedale-native ewes was due to the higher percent lamb crops produced by these two groups.

SUMMARY

1. The percent lamb crop and gross returns per ewe were highest for the Texas ewes and lowest for the Montana ewes.

2. The Corriedale-native and Texas ewes yeaned earlier than did the Montana ewes. However, the faster gaining lambs from the Montana ewes were heaviest at weaning or market age.

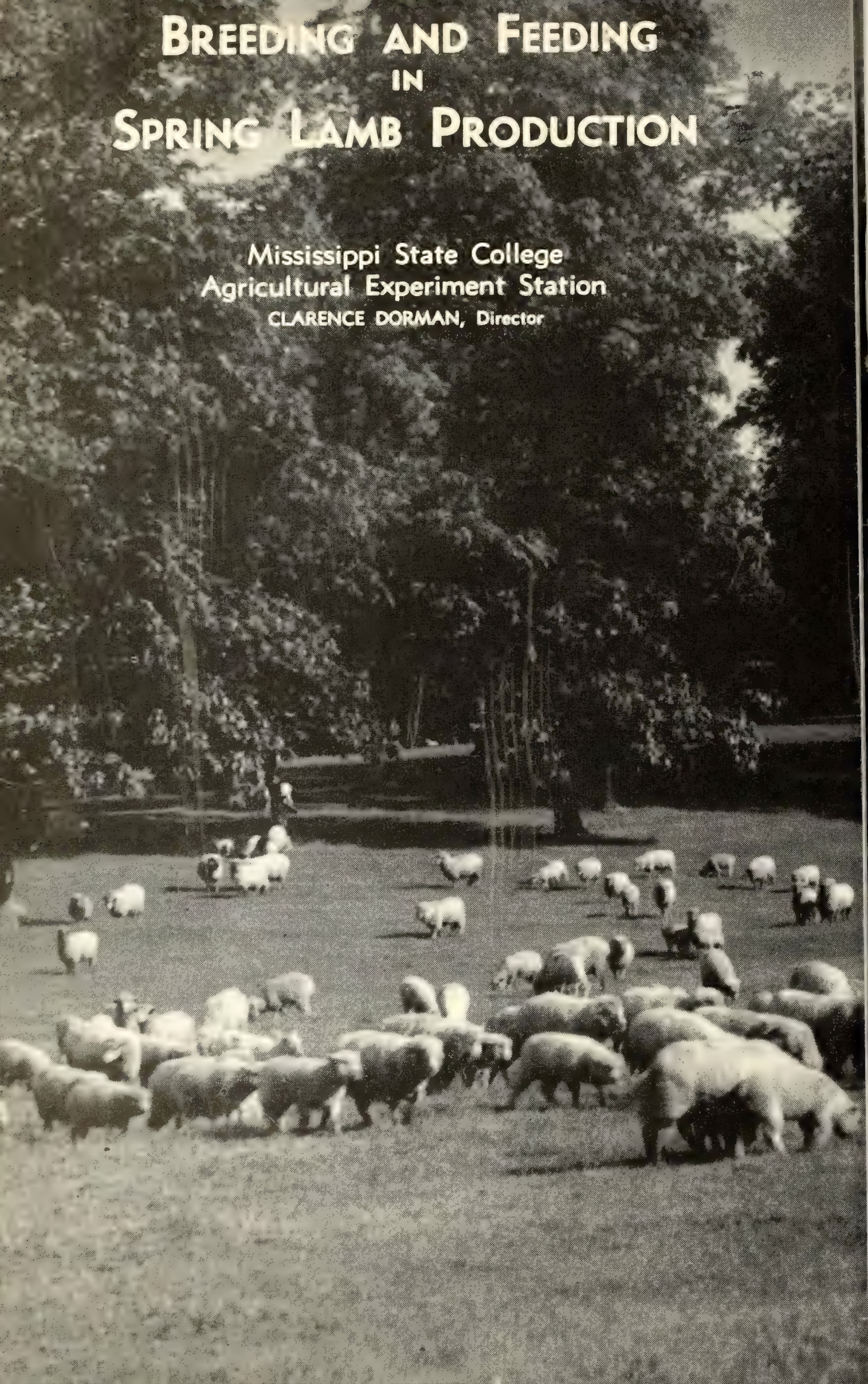
3. The wool clip was highest for the Montana ewes, followed closely by the Corriedale-native ewes.

4. There was relatively no difference in the market grade of the lambs produced by the Montana and Texas ewes, both of which graded higher than did the Corriedale-native ewes.

5. The Corriedale-native ewes were approximately equal in wool and lamb production to the Texas ewes and the Montana ewes. The experiment clearly indicates that either of the three methods of securing replacement ewes will prove satisfactory, with a slight advantage favoring the Corrieda'e-native and Texas ewes provided other good management practices are carried into effect.

BREEDING AND FEEDING IN SPRING LAMB PRODUCTION

Mississippi State College
Agricultural Experiment Station
CLARENCE DORMAN, Director



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Tests of
Corn Hybrids and Varieties In Mississippi
1946

By

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and A. L. HAMNER

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CORN HYBRIDS AND VARIETIES IN MISSISSIPPI[1/]

By ROBERT C. ECKHARDT, W. A. DOUGLAS and A. L. HAMNER[2/]

Corn performance tests designed to determine the most desirable strains, were continued in 1946 on four experiment stations in Mississippi. The most promising new hybrids from neighboring states were tested with the best open-pollinated varieties and older hybrids.

It is well recognized that open-pollinated varieties of corn differ greatly in adaptation and performance, but many farmers do not realize that some hybrids may be unsuited for planting in Mississippi, particularly hybrids that have been bred for conditions differing from those existing in the South. The performance tests of previous years have proven clearly that most northern hybrids are unsuited for use as full-season corns in the South because of poor husk extension and soft grain which makes them subject to serious insect damage. Only one northern hybrid, Pioneer 300, was included in the 1946 comparisons. It was included because a large amount of seed of it was offered for sale in the Delta in the spring of 1945 and 1946.

Each test contained 25 entries arranged in a balance lattice square design with six replications. Each plot was 2 rows wide and 10 hills long with rows and hills usually spaced 40 inches apart. Four seeds were planted per hill and later thinned to two plants per hill. Some of these tests had fertilizer applied before planting and all tests received at least 32 pounds of nitrogen per acre.

The hybrids and varieties tested and the source of seed are shown in table 1.

Seasonal Conditions

A very wet spring and early summer was unfavorable for crop growth, especially at Natchez and West Point. The Natchez test was not harvested because of irregular stands due to very heavy rains at the time of emergence. Corn yields for the entire state were slightly above the ten year average of 15.3 bushels per acre. The estimated 1946 yield was 16.5 bushels per acre.

Explanation of the Data Reported

Yields are based on 70 pounds of husked earcorn per bushel. Any two kinds of corn should differ by at least the number of bushels shown opposite the notation "least significant difference (5 percent level)" before any great confidence can be placed on the two entries being really different in yielding ability.

The percentages of plants lodged are based on actual counts, all plants broken below the top ear-bearing node (joint) were classified as stalk lodged, while all plants leaning 30 degrees or more from the vertical were classified as root lodged. Husk length is reported as the estimated husk extension beyond the ear tip, in inches. Although the percentages of earworm infested ears vary somewhat, these differences probably are not significant, and none of the inbreds, hybrids, and varieties can be considered to have shown any material degree of resistance to the earworm in these tests. All other notes are self-explanatory.

State-Wide Results

Hybrids

Fifteen of the entries were planted at all locations. The 4-station average for these entries are reported in table 2. Sev-

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[1/] Project AC-1 and PH-3 of the Mississippi Agricultural Experiment Station in cooperation with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, and the Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

[2/] Agronomist, Bureau of Plant Industry, Soils, and Agricultural Engineering, and the Mississippi Agricultural Experiment Station; Entomologist, Bureau of Entomology and Plant Quarantine; and Associate Entomologist, Mississippi Agricultural Experiment Station, respectively.

Table 1. Seed source of hybrids and varieties tested in 1946.

Hybrid or variety	Source of seed	Address
White Hybrids		
Dixie 11 (formerly Miss. 5111)	Miss. Agr. Exp. Sta. & U.S.D.A.	State College, Mississippi
Dixie 17	Miss. Agr. Exp. Sta. & U.S.D.A.	State College, Mississippi
Louisiana 468	Miss. Agr. Exp. Sta. & U.S.D.A.	State College, Mississippi
Tennessee 10	Tenn. Crop. Imp. Assn.	Knoxville, Tennessee
Louisiana 502	La. Agr. Exp. Sta. & U.S.D.A.	Baton Rouge, Louisiana
Yellow Hybrids		
N. C. 27 (formerly N.C. 5001)	N. C. Agr. Exp. Sta. & U.S.D.A.	Raleigh, North Carolina
Dixie 44 (formerly Tenn. 4004)	Tenn. Agr. Exp. Sta. & U.S.D.A.	Knoxville, Tennessee
Funk G714	Louisiana Seed Company	Alexandria, Louisiana
Funk G708	Louisiana Seed Company	Alexandria, Louisiana
Pioneer 300	King and Anderson	Clarksdale, Mississippi
White Varieties		
Station Mosby	Miss. Agr. Exp. Station	State College, Mississippi
Station Laguna	Miss. Agr. Exp. Station	State College, Mississippi
Jellicorse	W. Tenn. Exp. Station	Jackson, Tennessee
Cocke Prolific	N. E. La. Exp. Station	St. Joseph, Louisiana.
Smith Mosby	George Smith	Poplarville, Mississippi
Deaton Corn	J. C. Deaton	Paden, Mississippi
Stewart Corn	Argie Stewart	Picayune, Mississippi
Pigott Red Cob	Local Farmer	Poplarville, Mississippi
Tuxpan	La. Agr. Exp. Sta. & U.S.D.A.	Baton Rouge, Louisiana
Whatley Prolific	Whatley Bros.	Helena, Georgia
Yellow Varieties		
Calloway Jarvis	W. A. Calloway	Bosco, Louisiana
Sewell Jarvis	J. A. Sewell	Thaxton, Mississippi
Holly Springs Jarvis	Holly Springs Branch Station	Holly Springs, Mississippi
Hill Yellow Dent	La. Agr. Exp. Sta. & U.S.D.A.	Baton Rouge, Louisiana
Whatley Yellow Prolific	Whatley Bros.	Helena, Georgia
Carroway Prolific	J. C. Hester	Taylorsville, Mississippi

en hybrids, all in commercial production, were at the top in yield.

Two Dixie hybrids, Dixie 17 and Dixie 11, led in yield with average 4-station yields of 73 and 68 bushels, respectively. Dixie is a name given hybrids developed by members of Southern Corn Improvement Conference (consisting of U.S.D.A. and State Experiment Station workers in the Southeast). These hybrids must have been tested for a period of years at a number of locations and have been approved by the Conference to receive the regional designation "Dixie."

Dixie 11 (formerly Mississippi Experimental hybrid 5111) is similar in performance to Louisiana Hybrid 468. These two hybrids have three of their four component inbred lines in common. Dixie 11 has an excellent record for yield for the two years tested. It is a prolific white hybrid with medium to small sized ears which have sufficient husk protection against rice weevil for all but the southern part of Mississippi. The main fault of Dixie 11 is its susceptibility to lodging under some conditions.

Dixie 17 was the outstanding hybrid in yielding ability. Dixie 17 has an outstanding yield record for the past two years in Mississippi, Tennessee, North Carolina and Georgia where it has been thoroughly tested. It is similar in adaptation to Tennessee Hybrid 10 and as seed becomes available will undoubtedly replace much of the acreage now planted to Tennessee 10. Dixie 17 does not have as much protection from rice weevil as does Dixie 11 but has about the same degree of protection as Tennessee 10 and Station Mosby.

Louisiana Hybrid 502 differs by only one inbred from Louisiana Hybrid 468 and Dixie 11. It has a good yield rec-

Table 2. Summary of data from the main hybrid tests at Holly Springs, West Point, Stoneville, and Poplarville, 1946.

Entry	Acre yield	Plants erect at harvest	Lodging		Weevil ears	Ear-worm ears	Ear ht.	Ears per plant	Husk length	Stand
			Root	Stalk						
	bu.	pct.	pct.	pct.	pct.	pct.	ft.	no.	in.	pct.
Dixie 17	73.0	73	5	22	46	75	5	1.7	2.0	92
Dixie 11	68.1	70	12	18	29	66	4	1.8	2.1	95
La. 468	66.0	77	10	13	30	68	5	1.6	2.1	94
Funk G714	65.0	69	2	28	44	74	5	1.6	2.1	96
La. 502	63.8	59	14	27	22	64	5	1.8	2.4	94
N. C. 27	63.4	82	3	15	37	67	4	1.4	2.2	91
Tenn. Hybrid 10	62.6	70	5	25	46	81	4	1.6	1.8	88
*Station Mosby	59.5	72	10	18	38	72	5	1.2	2.0	93
*Jellicorse	55.2	75	4	21	45	75	4	1.4	2.0	86
*Station Leguna	54.9	73	9	19	53	78	5	1.2	1.9	90
*Hill Yellow Dent	51.6	82	4	14	22	66	5	1.0	2.5	89
*Sewell Jarvis	50.6	68	7	25	32	68	4	1.4	1.8	90
*Cockes Prolific	50.5	77	11	12	34	66	5	1.3	2.7	89
*Calloway Jarvis	45.7	77	8	15	39	67	4	1.4	2.2	90
*Holly Springs Jarvis	42.8	67	9	24	27	70	3	1.4	2.0	88

*Open-pollinated varieties

ord, and is slightly later, higher eared and somewhat more weevil resistant than either Louisiana 468 or Dixie 11.

Funk G714 and N. C. Hybrid 27 were about the same in yielding ability but N. C. 27 had less lodging and fewer ears damaged by rice weevils. Both hybrids have yellow grain, and lack husk protection for South Mississippi. Although not included in these tests, Louisiana Hybrid 1030 has been grown in many other tests over a period of years. It had the least damage from earworm on infested ears and the greatest percent of ears without earworm damage of any hybrid tested. It has had a good yield record and is fairly resistant to damage by rice weevil. The grain is mixed in color and of high quality. This hybrid is recommended for the area in Mississippi south of U. S. Highway 82.

Open-Pollinated Varieties

As in past years, Station Mosby was the highest yielding open-pollinated variety with Jarvis the lowest yielding variety. Jellicorse and Station Laguna were also high in yield, ranking below Station Mosby. None of the high yielding open-pollinated varieties had as much husk protection from rice weevil as is desired in South Mississippi.

Three strains of Jarvis were tested in 1946. Sewell Jarvis was the best in yield, Calloway next and Holly Springs poorest. Sewell Jarvis has a medium dent kernel and is fairly soft while the other two strains are hard and flinty. The yield of the best strain, Sewell Jarvis, was considerably less than that of the better open-pollinated strains such as Station Mosby.

Varieties Planted Only in South Mississippi

In addition to the varieties planted at all locations, several additional varieties were planted at Poplarville (table 3). These were the Louisiana strain of Tuxpan, Whatley Prolific, Yellow Whatley, Smith Mosby, Stewart Corn, and Pigott Red Cob. All yielded less than the hybrids and most of the other open-pollinated varieties in test.

They all have one desirable character—a long tight husk which makes them relatively resistant to weevil. The lowest yielding variety, Pigott Red Cob, had the smallest percentage of ears infested with rice weevil. However, it is very doubtful whether a farmer can afford to take a 20 to 30 percent loss in yield

Table 3. Main hybrid corn test, Poplarville, 1946.

Entry	Acre yield	Plants erect at harvest	Lodging		Weevil ears	Ear-worm ears	Ear ht.	Ears per plant	Husk length	Stand
			Root	Stalk						
	bu.	pct.	pct.	pct.	pct.	pct.	ft.	no.	in.	pct.
Dixie 17	59.0	45	13	42	59	78	4	1.7	1.8	88
Dixie 11	53.5	32	32	36	40	73	4	1.6	1.8	91
N. C. 27	52.7	58	8	34	48	67	4	1.2	2.3	92
Funk G714	52.0	34	7	59	55	74	4	1.5	2.5	92
La. 468	51.2	50	22	28	47	74	4	1.4	2.2	93
*Station Mosby	49.7	43	24	33	56	74	5	1.1	1.8	92
Tenn. 10	48.4	48	12	40	65	84	4	1.5	1.7	84
La. 502	46.5	16	30	54	28	64	5	1.6	2.5	91
*Station Laguna	45.8	37	23	40	68	80	5	1.1	1.8	91
*Jellicorse	44.5	61	8	31	66	80	3	1.4	1.7	82
*Hill Yellow Dent	42.5	61	10	29	25	59	5	1.0	2.5	89
*Whatley Prolific	41.1	36	28	36	15	51	5	1.5	3.2	75
*Smiths Mosby	39.8	38	29	33	20	59	5	0.9	3.3	85
*Cockes Prolific	39.1	45	30	25	45	75	4	1.2	3.2	87
*Tuxpan	38.8	31	46	23	19	71	5	0.9	2.8	87
*Stewart Corn	38.5	52	25	23	18	52	4	0.9	3.3	88
*Sewell Jarvis	37.2	50	18	32	46	73	3	1.3	1.5	79
*Calloway Jarvis	35.9	55	22	23	52	63	3	1.4	2.3	84
*Holly Springs Jarvis	35.8	56	24	20	40	70	2	1.3	2.2	85
*Yellow Whatley	35.5	32	38	30	23	65	4	1.1	2.7	68
*Pigott Red Cob	35.4	40	34	26	7	47	4	1.1	3.5	88
*Carroway Prolific	33.6	47	22	31	38	68	3	1.2	2.5	78

Least significant difference (5 percent level) 6.3.
*Open-pollinated varieties.

Table 4. Main hybrid corn test, Holly Springs, 1946.

Entry	Acre yield	Plants erect at harvest	Lodging		Ear-worm ears	Ear ht.	Ears per plant	Husk length	Stand
			Root	Stalk					
	bu.	pct.	pct.	pct.	pct.	ft.	no.	in.	pct.
Dixie 17	108.5	83	0	17	60	6	2.0	2.0	92
La. 468	96.1	92	4	4	49	6	1.9	2.0	93
Tenn. Hybrid 10	92.0	76	0	24	66	5	1.9	2.0	85
La. 502	91.0	87	2	11	54	6	2.1	2.3	91
Dixie 11	90.7	88	1	11	44	5	1.9	2.2	94
Funk G714	86.9	90	0	10	52	6	1.7	2.0	95
N. C. 27	85.8	96	0	4	47	5	1.5	2.2	89
*Station Mosby	83.5	91	1	8	53	6	1.5	2.0	92
Funk G707	82.5	61	2	37	48	5	1.5	2.0	88
*Station Laguna	77.1	93	1	6	61	6	1.3	2.0	90
*Cockes Prolific	76.9	96	2	2	52	6	1.6	2.5	87
*Hill Yellow Dent	74.4	99	0	1	63	6	1.1	2.7	89
*Jellicorse	73.8	80	2	18	54	5	1.5	2.2	85
*Deaton Corn	73.2	73	0	27	45	6	1.8	2.0	89
*Sewell Jarvis	72.9	81	0	19	46	5	1.6	2.2	92
Dixie 44	70.6	88	0	12	65	5	1.0	1.7	86
*Calloway Jarvis	66.4	93	0	7	50	5	1.5	2.2	92
*Holly Springs Jarvis	58.5	70	1	29	45	4	1.5	2.0	92
Pioneer 300	45.8	56	2	42	67	4	1.0	1.2	84

Least significant difference (5 percent level) 7.6
*Open-pollinated varieties.

in order to gain the weevil resistance, since it has been shown that a tight crib and fumigation will control rice weevil at the cost of a few cents per bushel.

Hybrids Planted Only in North Mississippi

Three hybrids were planted at Holly Springs, West Point and Stoneville in ad-

Table 5. Main hybrid corn test, West Point, 1946.

Entry	Acre yield	Weevil ears	Ear-worm ears	Ear ht.	Ears per plant	Husk length	Stand
	bu.	pct.	pct.	ft.	no.	in.	pct.
Funk G714	41.5	26	94	4	1.3	2.5	97
Dixie 11	40.6	13	90	4	1.5	2.3	98
Dixie 17	39.3	32	90	4	1.3	2.2	93
Tenn. Hybrid 10	36.6	26	92	4	1.3	2.2	95
*Station Laguna	36.5	28	95	4	1.0	2.0	94
Dixie 44	36.4	68	93	4	1.1	2.0	97
N. C. 27	35.9	22	92	4	1.1	2.3	93
La. 502	35.8	9	94	4	1.5	2.7	93
Funk G708	35.5	36	94	4	1.0	2.0	95
La. 468	34.4	12	90	4	1.3	2.3	95
*Hill Yellow Dent	32.9	8	89	4	0.9	2.5	89
*Station Mosby	32.5	19	94	4	0.9	2.0	95
*Jellicorse	32.2	31	90	3	1.2	2.3	88
*Deaton Corn	27.0	9	85	4	1.3	2.5	92
*Sewell Jarvis	26.5	24	89	3	1.2	2.0	95
*Cockes Prolific	26.3	15	93	4	1.0	3.0	92
*Calloway Jarvis	24.5	24	92	3	1.2	2.2	95
Pioneer 300	21.7	48	92	2	0.8	2.2	96
*Holly Springs Jarvis	18.8	21	88	3	1.0	2.0	87

Least significant difference (5 percent level) 4.8

*Open-pollinated varieties.

Table 6. Main hybrid corn test, Stoneville, 1946.

Entry	Acre yield	Plants erect at harvest	Lodging		Weevil ears	Ear-worm ears	Ear ht.	Ears per plant	Husk length	Stand
			Root	Stalk						
	bu.	pct.	pct.	pct.	pct.	pct.	ft.	no.	in.	pct.
Dixie 11	87.5	90	2	8	33	57	5	2.0	2.0	97
Dixie 17	85.2	92	1	7	47	72	5	1.8	2.0	93
La. 468	82.4	88	4	8	30	57	5	1.8	1.8	94
La. 502	81.7	75	9	16	29	44	6	1.9	2.0	99
Funk G714	79.6	84	0	16	52	76	6	1.7	1.5	102
N. C. 27	79.2	92	1	7	41	61	5	1.6	2.0	91
Tenn. 10	73.4	87	2	11	47	82	5	1.7	1.3	90
*Station Mosby	72.4	82	4	14	38	67	6	1.4	2.0	92
Funk G708	71.1	76	0	24	46	84	5	1.5	1.3	92
*Jellicorse	70.5	85	2	13	39	77	5	1.7	1.8	89
*Sewell Jarvis	65.8	72	3	25	26	63	4	1.7	1.7	92
Dixie 44	64.2	95	1	4	67	93	5	1.1	0.8	89
*Station Laguna	60.1	88	2	10	64	75	6	1.2	1.8	84
*Cockes Prolific	59.7	91	1	8	42	46	6	1.3	2.2	90
*Holly Springs Jarvis	58.0	76	1	23	20	77	4	1.7	2.0	89
*Deaton Corn	57.9	69	5	26	38	60	6	1.7	1.5	91
*Hills Yellow Dent	56.5	87	2	11	32	52	6	1.1	2.2	88
*Calloway Jarvis	56.1	83	3	14	40	63	4	1.5	2.0	87
Pioneer 300	55.6	88	1	11	62	97	3	1.1	0.7	87

Least significant difference (5 percent level) 6.5.

*Open-pollinated varieties.

dition to those planted at all stations (tables 4, 5, 6). These hybrids were Pioneer 300, Dixie 44, and Funk G708. Pioneer 300 was the lowest yielding entry in test at Holly Springs and Stoneville and only Holly Springs Jarvis was lower at West Point. Pioneer 300 is a single-eared hybrid of Corn Belt type with no husk protection against birds and weevils. Except for early hogging off, or for late planting, there seems to be no place for these early Corn Belt hybrids in Mississippi.

Funk G708 has not had as good a performance record as Funk G714. It is susceptible to stalk lodging late in the season.

Dixie 44 is a yellow hybrid which is primarily single-eared and relatively early. It has no husk protection against rice weevil but can be grown in north Mississippi where rice weevils are not a problem. Dixie 44 has equaled Station Mosby in yield on land producing 60 bushels or less per acre, but is not as productive as Station Mosby on land producing yields above 60 bushels. Dixie 44 stands well at harvest time and could profitably replace most of the acreage now growing early Corn Belt types such as Pioneer 300, or Jarvis, if an early yellow corn is desired.

General Recommendations

Adapted hybrids can be expected to yield from 10 to 20 percent more than the best open-pollinated varieties and as much as 50 percent more than poor open-pollinated varieties and unadapted hybrids. A 20 percent increase on a 30-bushel yield level is 6 bushels per acre but the same 20 percent increase on a 70-bushel yield level is 14 bushels per acre.

Recommended Hybrids and Varieties

North Mississippi (North of U. S. Highway 82)

*Jellicorse
*Neal Paymaster
*Station Mosby
Dixie 11 (formerly Mississippi Hybrid 5111)
Dixie 17 (no seed available in 1947)
Funk G714
Louisiana Hybrid 468
North Carolina 27
Tennessee 10

Central Mississippi (North of U. S. Highway 80 and South of U. S. 82)

*Station Mosby
Dixie 11
Funk G714
Louisiana Hybrid 468
Louisiana Hybrid 502
Louisiana Hybrid 1030
North Carolina 27

South Mississippi (South of U. S. Highway 80)

No open-pollinated varieties are entirely satisfactory for South Mississippi but the following are some of the best.

*Hill Yellow Dent
*Station Mosby (badly damaged by rice weevil)
*Stewart Corn
*Whatley Prolific
Dixie 11
Louisiana Hybrid 468
Louisiana Hybrid 502
Louisiana Hybrid 1030

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*Open pollinated varieties.

Recommended Cultural Practices

In order to obtain the most profitable return from an investment in hybrid seed corn, certain cultural practices are necessary. The following recommendations should be followed in order to grow corn profitably:

1. Seed: Plant an adapted high yielding variety or hybrid.

2. Fertilizer: Delta Area—apply 300 pounds of ammonium nitrate, or 600 pounds of nitrate of soda (96 pounds of nitrogen) per acre in a band at the bottom of the old furrow and bed on this band. If land is to be flatbroken, apply in a band with fertilizer attachment on

breaking plow. On land deficient in phosphorus and potash, 500 pounds of 6-8-4 can be substituted for 100 pounds of ammonium nitrate or 200 pounds of nitrate of soda. The 6-8-4 should be applied before or during the planting.

Hill Area—use the same amount of fertilizer as above except apply 1/3 before or during planting and 2/3 as a side dressing when corn is 1 to 3 feet high. Complete fertilizer should go under corn or in bands on each side of and slightly below seed when applied with fertilizer attachment on corn planter.

3. Time of planting: North Mississippi, April 15 - May 1; Central Mississippi, April 1 - April 15; South Mississippi, March 15 - April 1; or as soon thereafter as possible.

4. Rate of planting: 10,000 plants per acre should be the goal. This is approximately one plant each 15 inches in rows 40 inches apart. This rate should be used to make efficient use of the large amounts of fertilizer. Thick spacing also shades out weeds. In order to obtain the above stand, plant at least one seed every 12 inches to allow for losses caused by insects, etc.

5. Cultivation: The land should be cultivated often enough to control weeds.

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Tests of
Cotton Varieties
For
Hill Soils of Mississippi
1946

By

J. F. O'KELLY

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

Cotton Variety Tests, 1946

By J. F. O'KELLY

The field data for these tests were collected by S. P. Crockett at Holly Springs and H. A. York at Raymond.

Cotton variety trials extending over many years have rather definitely established the merits of varieties available to farmers of this State. The number used could very well be reduced to a half dozen or less without a reduction in the farmer's income and without reducing the quality or quantity of the State's production.

Weather and insect damage in the 1946 season were so severe at the Poplarville Station that no attempt was made to harvest any cotton. Conditions were little better at Raymond and State College, and moderate yields were possible only through the use of calcium arsenate for

Table 1. Yields at the several locations, 1946.

Variety	Pounds lint per acre					
	Holly Springs		State College	Raymond		Average
	Hill	Valley		Hill	Valley	
Empire	528	362	412	413	233	390
Washington 3070	548	380	395	330	233	377
Delfos 9169	528	263	453	384	235	373
Hi-Bred	517	303	379	443	218	372
Deltapine 14	479	363	434	347	224	369
Coker 100W-6	517	348	423	335	211	367
Coker Staple	515	342	394	358	197	361
Stoneville 5A	489	332	414	371	196	360
Cleveland 54	479	346	378	372	216	358
Miller	443	325	418	373	232	358
Stoneville 2B	500	329	412	318	190	350
Delfos 4219	501	344	386	311	184	345
Bobdel	498	287	408	291	188	334
Bobshaw 1	458	293	435	315	170	334
Delfos 531C	459	264	370	388	177	332
Delfos 651	441	265	412	321	206	329

Table 2. Cotton varieties: Holly Springs, hill soil, 1946.

Variety	Pounds lint per acre	Total acre value			Length inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Washington 3070	547.7	$223.24	$216.94	$195.85	1 1/32	37.0	182
Empire	528.0	214.08	208.01	187.68	1 1/32	38.0	160
Delfos 9169	527.7	216.02	209.69	188.58	1 1/16	37.1	182
Hi-Bred	516.6	195.50	191.11	170.44	7/8	42.9	155
Coker 100W-6	516.6	209.78	203.84	183.95	1 1/32	37.7	189
Coker Staple	514.8	210.63	204.45	183.86	1 1/16	37.2	193
Delfos 4219	500.7	208.02	202.01	181.98	1 1/16	34.5	216
Stoneville 2B	500.2	204.42	198.67	179.41	1 1/32	36.5	172
Bobdel	498.5	207.35	201.37	181.43	1 1/16	34.3	234
Stoneville 5A	489.0	199.96	194.33	175.51	1 1/32	36.4	208
Deltapine 14	479.4	192.48	186.96	168.51	1 1/32	40.0	192
Cleveland 54	478.9	192.49	186.27	164.95	15/16	38.0	193
Deflos 531C	459.3	190.25	184.74	166.37	1 1/16	35.0	227
Bobshaw 1	458.3	187.09	181.82	164.18	1 1/32	36.7	202
Miller	443.3	178.72	172.96	152.79	31/32	37.9	172
Delfos 651	441.0	181.52	176.23	158.59	1 1/16	36.1	225

Table 3. Cotton variety averages: Holly Springs, hill soil, 1942-1946.

Variety	Annual lint yields					Averages				
	1942	1943	1944	1945	1946	Pounds lint	Total value (2)	Staple length	Lint percentage	Bolls per lb. lint
Hi-Bred	735	369	413	719	517	551	139.07	27/32	43.3	155
Coker 100 Wilt	732	371	408	603	517	526	150.13	1 1/32	37.4	190
Deltapine 14	670	349	409	716	479	525	146.79	1 1/32	40.6	192
Stoneville 2B	737	320	437	541	500	507	147.56	1 1/16	36.4	185
Miller	653	373	364	680	443	503	139.13	31/32	38.6	169
Bobshaw 1	790	328	362	534	458	494	139.65	1 1/32	37.0	202
Cleveland 54	622	313	362	639	479	483	133.33	29/32	38.2	192
Stoneville 5A	635	342	347	579	489	478	138.70	1 1/32	37.1	209
Delfos 651 (1)	665	298	343	481	441	446	133.67	1 3/32	36.0	222
Delfos 531C	615	293	334	480	459	436	135.09	1 3/32	35.1	227
Bobdel (1)	514	273	304	575	498	433	131.85	1 1/16	34.4	226

(1) Data for closely related strain were used for years before current strain was tested.
(2) Based on middling grade.

Table 4. Cotton varieties: Holly Springs, valley soil, 1946.

Variety	Pounds lint per acre	Total acre value			Length inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Washington 3070	379.8	$159.51	$154.95	$139.76	1 1/16	32.8	202
Deltapine 14	363.5	152.58	148.22	132.22	1 1/8	35.6	204
Empire	361.7	152.42	148.08	133.43	1 3/32	33.0	188
Coker 100W-6	347.8	144.94	140.76	126.85	1 1/16	34.0	197
Cleveland 54	345.9	143.05	138.55	122.81	31/32	33.5	211
Delfos 4219	343.9	144.24	140.11	126.36	1 1/16	33.0	204
Coker Staple	342.3	144.63	140.52	126.66	1 3/32	32.6	220
Stoneville 5A	331.6	139.47	135.49	122.06	1 3/32	33.3	217
Stoneville 2B	329.1	138.24	134.29	120.96	1 3/32	33.5	192
Miller	325.2	134.63	130.73	117.23	1	33.9	201
Hi-Bred	303.1	120.22	116.13	102.49	29/32	38.4	163
Bobshaw 1	292.6	123.22	119.71	108.00	1 1/16	32.4	240
Bobdel	286.9	121.23	117.78	106.17	1 3/32	32.6	216
Delfos 651	265.1	112.40	109.22	98.48	1 3/32	32.1	252
Delfos 531C	263.8	116.93	111.26	98.46	1 5/32	32.7	216
Delfos 9169	263.3	110.29	107.13	96.60	1 1/16	33.2	215

Table 5. Cotton variety averages: Holly Springs, valley soil, 1942-1946.

Variety	Annual lint yields					Averages				
	1942	1943	1944	1945	1946	Pounds lint	Total value (2)	Staple length	Lint percentage	Bolls per lb. lint
Cleveland 54	685	580	626	764	346	600	164.47	31/32	35.5	199
Miller	733	589	622	729	325	600	164.85	1	35.9	181
Deltapine 14	647	652	588	715	363	590	169.15	1 3/32	38.2	206
Coker 100 Wilt	672	579	597	755	348	590	168.78	1 1/16	35.3	198
Hi-Bred	706	635	565	738	303	589	147.77	7/8	40.4	156
Stoneville 5A	629	590	641	711	332	581	167.26	1 1/16	35.2	211
Stoneville 2B	605	641	538	693	329	561	166.41	1 3/32	35.0	183
Bobshaw 1	706	561	511	679	293	550	154.99	1 1/16	35.0	209
Delfos 651 (1)	567	528	541	621	265	504	165.51	1 5/32	33.4	231
Delfos 531C	538	537	558	592	264	498	167.71	1 5/32	33.5	231
Bobdel (1)	443	473	458	591	287	450	144.23	1 1/8	32.4	230

(1) Data for closely related strain were used for years before current strain was tested.
(2) Based on middling grade.

boll weevil control. Probably 80 percent of the cotton obtained at State College was set in August. This percentage of the crop is usually set in July. Conditions were only slightly better at Holly Springs.

Tests at all locations were liberally fertilized. This made it possible for the plants to recover with the appearance of normal weather in late July and August and, hence, to set bolls under the protection of calcium arsenate. A late frost permitted many of these late bolls to open normally.

Prices for lint cotton used in the calculations were based on ten weeks of the marketing season at Memphis, Tennessee, beginning early in September. The value used for seed was $60.00 a ton. This is conservatively low in comparison with prices received for seed after controls were lifted. In computing acre values the same price was used for seed regardless of whether the assumed lint grade was middling, strict low middling, or low middling. This means that acre values are a little high where low grades of lint are assumed. There is no indication, however, that this difference materially affects the showing made by any particular variety.

A study of the averages indicates there

Table 6. Cotton varieties: State College, 1946.

Variety	Pounds lint per acre	Total acre value			Length inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Delfos 9169	453.4	$186.83	$181.39	$163.26	1 1/16	35.9	190
Bobshaw 1	435.4	179.21	173.99	156.57	1 1/16	36.1	191
Deltapine 14	433.9	175.74	170.54	153.18	1 1/16	39.2	185
Coker 100 W-6	423.0	173.82	168.75	151.61	1 3/32	37.3	185
Miller	418.4	169.40	164.38	147.02	1	37.8	165
Stoneville 5A	414.0	170.45	165.69	149.75	1 1/32	35.2	208
Delfos 651	411.9	171.95	167.01	150.33	1 3/32	34.5	215
Stoneville 2B	411.6	170.05	165.11	148.44	1 3/32	36.3	178
Empire	411.6	168.50	163.76	147.92	1 1/32	36.2	164
Bobdel	408.4	169.99	165.09	148.55	1 3/32	35.0	215
Washington 3070	395.3	162.53	157.78	141.97	1 1/16	36.3	169
Coker Staple	394.2	163.04	158.31	142.34	1 3/32	36.1	197
Delfos 4219	385.7	160.63	156.01	140.58	1 1/16	34.1	204
Hi-Bred	379.3	149.60	144.67	127.79	15/16	42.0	150
Cleveland 54	378.2	153.52	148.98	133.29	1	37.3	184
Delfos 531C	369.9	157.13	152.69	136.41	1 1/8	33.6	220

Table 7. Cotton variety averages: State College, 1942-1946.

Variety	Annual lint yields					Averages				
	1942	1943	1944	1945	1946	Pounds lint	Total value (2)	Staple length	Lint percentage	Bolls per lb. lint
Deltapine 14	621	586	607	429	434	535	150.24	1 1/16	40.5	186
Miller	584	541	548	485	418	515	142.68	31/32	37.5	171
Cleveland 54	600	494	571	531	378	515	138.68	15/16	37.8	188
Coker 100 Wilt	584	556	537	410	423	502	142.43	1 1/32	37.1	189
Hi-Bred	575	612	436	483	379	497	124.27	7/8	43.2	150
Stoneville 2B	572	511	510	474	412	496	146.10	1 1/16	35.9	184
Stoneville 5A	531	541	525	466	414	495	141.59	1 1/32	36.4	207
Bobshaw 1	527	480	489	453	435	477	137.01	1 1/32	36.6	201
Delfos 651 (1)	520	482	480	380	412	455	141.96	1 3/32	34.5	221
Delfos 531C	515	486	466	363	370	440	140.75	1 1/8	34.1	226
Bobdel (1)	438	473	414	428	408	432	133.53	1 3/32	33.8	222

(1) Data for closely related strain were used for years before current strain was tested.
(2) Based on middling grade.

is no change in the varieties best suited to the hill areas of the state. These include Deltapine and the Stoneville strains, with Coker 100 Wilt coming to the front as a strong competitor. A few other varieties are equally as good in special cases.

Empire, a Stoneville selection from Georgia, has made a very creditable showing since its introduction a few years ago. It yields quite well and, like Bobshaw, has a strong fiber. It can be used more as soon as a source is established for an adequate supply of breeder seed.

Seed for these tests was obtained in all cases from the originators.

There is some indication that the supply of good planting seed for the 1947 season may be inadequate, especially if there should be a considerable increase in acreage planted and much planting over should be necessary. Farmers would do well to:

1. Make certain that any seed to be planted will germinate well. Send a sample to the State Seed Laboratory, State College, if necessary.

2. Provide enough surplus seed to plant over at least one-fourth of the acreage if necessary.

Table 8. Cotton varieties: Raymond, hill soil, 1946.

Variety	Pounds lint per acre	Total acre value			Length inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hi-Bred	443.4	$168.31	$164.54	$146.81	7/8	42.2	166
Empire	412.6	167.98	163.24	147.35	1 1/32	37.2	185
Delfos 531C	387.8	161.59	156.94	141.23	1 3/32	34.8	246
Delfos 9169	384 0	156.81	152.20	136.27	1	36.2	203
Miller	372.7	150.10	145.25	128.29	31/32	38.1	201
Cleveland 54	372.2	150.45	145.61	128.68	31/32	37.4	219
Stoneville 5A	370.6	151.88	147.62	133.35	1 1/32	36.0	231
Coker Staple	358.2	147.27	142.98	128.65	1 1/16	36.3	230
Deltapine 14	347.0	140.21	136.05	122.17	1 1/16	39.7	216
Coker 100W-6	335.5	137.87	133.84	120.42	1 1/16	36.4	221
Washington 3070	330.3	135.43	131.47	118.26	1 1/16	36.8	192
Delfos 651	321.3	132.55	128.69	115.84	1 1/16	35.7	238
Stoneville 2B	317.7	131.14	127.32	114.62	1 1/16	35.6	201
Bobshaw 1	314.6	128.93	125.32	113.20	1 1/32	36.0	216
Delfos 4219	311.3	128.79	125.21	113.22	1 1/32	34.4	232
Bobdel	290.6	119.30	115.96	104.77	1 1/32	35.7	247

Table 9. Cotton variety averages: Raymond, hill soil, 1942-1946.

Variety	Annual lint yields					Averages				
	1942	1943	1944	1945	1946	Pounds lint	Total value (2)	Staple length	Lint percentage	Bolls per lb. lint
Hi-Bred	710	634	630	482	443	580	140.71	13/16	42.7	165
Coker 100 Wilt	714	603	507	470	335	546	147.85	1 1/32	37.3	206
Deltapine 14	762	568	601	424	347	540	145.11	1 1/32	40.8	207
Bobshaw 1	718	607	554	408	315	520	141.15	1	37.1	217
Cleveland 54	713	590	556	371	372	520	136.79	29/32	37.6	210
Stoneville 2B	758	551	549	398	318	515	144.03	1 1/16	36.7	195
Miller	694	551	548	405	373	514	138.12	15/16	38.1	189
Stoneville 5A	677	544	544	434	371	514	141.22	1	37.6	220
Delfos 651 (1)	683	498	488	448	321	488	146.13	1 3/32	35.9	232
Delfos 531C	703	483	489	368	388	486	150.65	1 1/8	35.8	236
Bobdel (1)	599	464	454	335	291	429	129.04	1 1/16	34.7	236

(1) Data for closely related strain were used for years before current strain was tested.

(2) Based on middling grade.

Plenty of good seed for prompt planting when conditions are right is excellent crop insurance.

At least a small surplus of planting seed is especially desirable for the grower of certified seed and certified lint. Having to plant a part of the acreage over with another kind of cotton can completely upset the farmer's plans for certification.

Table 10. Cotton varieties: Raymond. valley soil, 1946.

Variety	Pounds lint per acre	Total acre value			Length inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Delfos 9169	235.1	$97.79	$94.97	$85.57	1 1/16	34.3	191
Empire	233.3	97.68	94.89	85.44	1 3/32	34.0	185
Washington 3070	233.3	97.25	94.57	85.59	1 1/32	33.2	214
Miller	232.0	95.81	93.02	83.39	1	34.3	189
Deltapine 14	224.0	92.14	89.46	80.50	1 1/16	36.2	218
Hi-Bred	217.7	86.35	83.41	73.61	29/32	38.4	167
Cleveland 54	215.9	89.90	87.31	78.35	1	33.0	225
Coker 100W-6	211.0	88.31	85.88	77.76	1 1/32	32.6	215
Delfos 651	205.6	86.53	84.06	75.73	1 3/32	33.2	238
Coker Staple	196.6	82.95	80.60	72.63	1 3/32	32.8	221
Stoneville 5A	196.4	82.06	79.70	71.85	1 1/16	33.6	222
Stoneville 2B	189.7	79.25	76.97	69.38	1 1/16	33.6	184
Bobdel	188.5	79.43	77.17	69.54	1 3/32	33.0	262
Delfos 4219	184.4	78.30	76.08	68.71	1 1/16	31.2	233
Delfos 531C	177.2	75.13	73.00	65.83	1 3/32	32.1	240
Bobshaw 1	170.4	71.47	69.51	62.95	1 1/32	32.3	209

Table 11. Cotton variety averages: Raymond, valley soil, 1942-1946.

Variety	Annual lint yields				Averages				
	1942	1943	1944	1946	Pounds lint	Total value (2)	Staple length	Lint percentage	Bolls per lb. lint
Deltapine 14	731	921	985	224	715	203.96	1 3/32	38.7	199
Bobshaw 1	791	826	1022	170	702	189.63	1 1/32	35.1	191
Cleveland 54	679	747	1068	216	677	179.06	31/32	34.7	202
Hi-Bred	561	923	1003	218	676	162.82	7/8	40.0	154
Coker 100 Wilt	672	792	994	211	667	192.39	1 1/16	34.7	199
Miller	650	727	1039	232	662	175.43	1	35.9	174
Stoneville 2B	651	786	1007	190	658	195.72	1 3/32	34.4	182
Stoneville 5A	638	765	958	196	639	181.53	1 1/16	35.1	207
Delfos 651 (1)	658	659	916	206	610	197.33	1 5/32	34.0	227
Delfos 531C	627	671	915	177	597	197.94	1 5/32	33.5	223
Bobdel (1)	546	733	824	188	573	185.27	1 5/32	32.8	229

(1) Data for closely related strain were used for years before current strain was tested.
(2) Based on middling grade.

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STATE COLLEGE

Farm Management And Production Costs

ON 40 FARMS IN NORTHEAST MISSISSIPPI

By

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Farm Management and Production Costs

ON 40 FARMS IN NORTHEAST MISSISSIPPI

By W. J. EDENS[1]

This bulletin reports a study, by the cost account method, of 40 dairy and cotton farms in Northeast Mississippi for the calendar year 1944. The purpose of the study was to determine farm costs and farm management practices in their relation to production problems and incomes, especially on farms producing milk for sale, and with possible recommendations for adjustments. Attention in particular is given to the costs of producing milk and cotton in their relationship to types of farm organization, and profits derived from these major enterprises as well as from minor enterprises and the farm business as a whole.

Most of the farms in Northeast Mississippi produce cotton and a large number keep milk cows. Cotton has been the principal income crop since the area was first settled. Since the turn of the century, it has been demonstrated that a single row-crop enterprise as the main source of income involves considerable risk and does not give a return to the farm business as a whole comparable to that which is realized when income enterprises are more diversified. Consequently, farmers and various agricultural agencies have been endeavoring to find the best means and methods to be used in providing the most profitable combination of enterprises for farms in each of the naturally defined areas of the State.

Emphasis has been placed on more livestock production as well as improved practices in growing crops. For the past three decades, much attention has been given to dairying as a supplement to cotton production. Agricultural and various business and civic agencies have encouraged the establishment of milk processing plants such as cheese factories, creameries, and condenseries in many communities of the State with most of the larger plants located in Northeast Mississippi. Fifty-seven of these plants have been established since 1912. At present, 31 are in operation with most of the fatalities having occurred among creameries. Nineteen of the 31 plants now in operation are located in the 11 counties constituting the Northeast Mississippi Milkshed Area.[2]

With the coming of these plants, the dairy cow population in the respective communities, or patronage areas, increased considerably. Many thought that this step in farm enterprise diversification would solve the one-crop system of farming. It has helped; but other problems have arisen such as low production per cow, unprofitable methods of feeding, high-cost transportation, low production during winter months making it difficult for milk plants to operate efficiently during that period, and dairy cattle diseases, and parasites. While some farmers appeared to be profiting by adding dairying to their business, others appeared to be deriving little benefits from milking cows along with the production of cotton.

Method of Selecting Farms

Farms selected for this study were suggested by county agricultural agents, milk plant managers and their field men, county representatives of the Agricultural Adjustment Agency, and local representatives of the Soil Conservation Service. These agricultural leaders were requested by personal interview to suggest farmers who, they thought, were progressive in their farm operations, would be interested in making a study of their farm busi-

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[1] Formerly Professor of Agricultural Economics, Mississippi State College; now President of Arkansas State College.

[2] Development of the Dairy Industry in Mississippi, by D. W. Parvin. Mississippi Agricultural Experiment Station Bulletin 422, July, 1945.

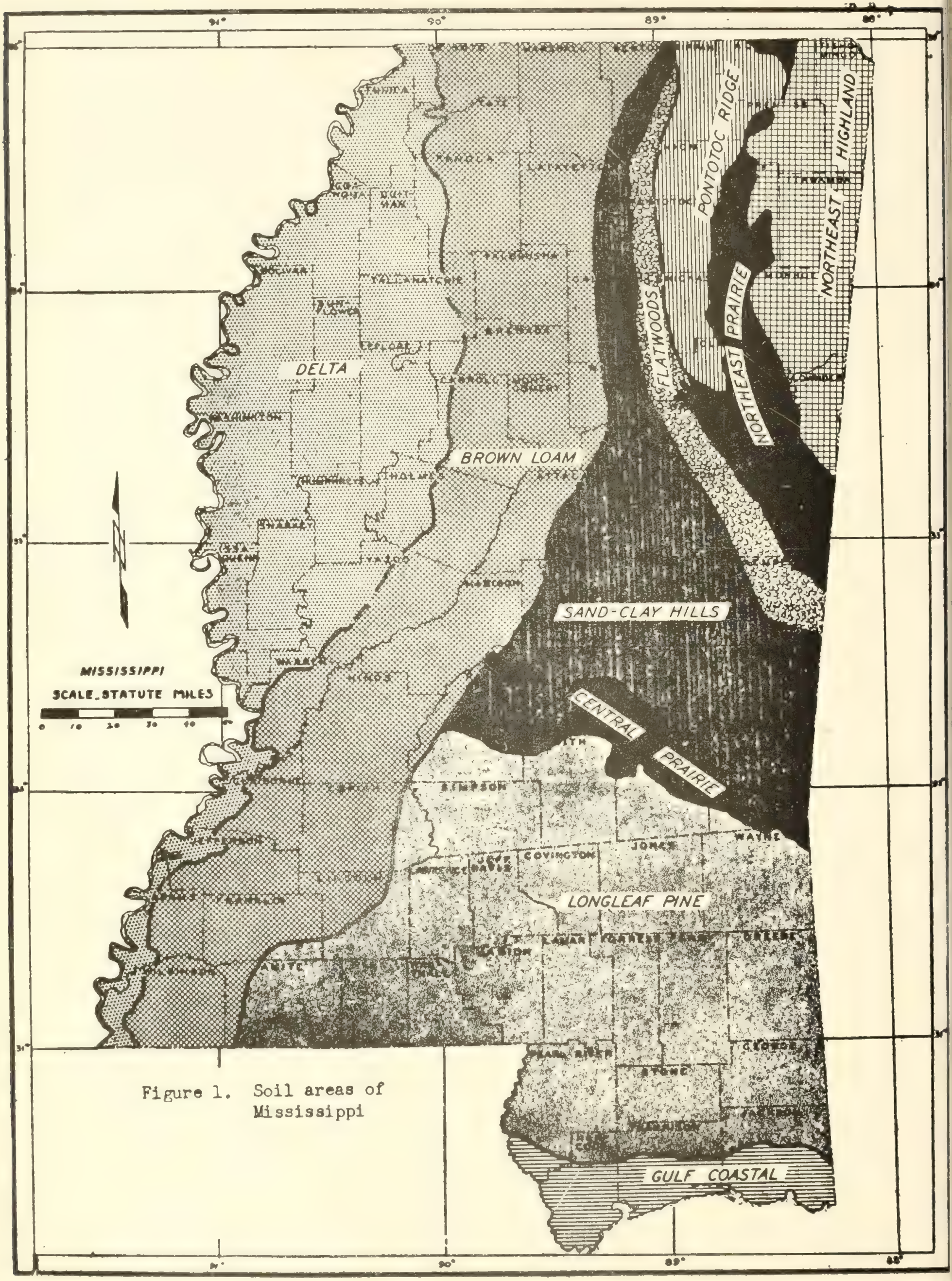
91°
90°
89°
88°
PONTOTOC RIDGE
NORTHEAST HIGHLAND
FLATWOODS
NORTHEAST PRAIRIE
DELTA
BROWN LOAM
SAND-CLAY HILLS
CENTRAL PRAIRIE
LONGLEAF PINE
GULF COASTAL
MISSISSIPPI
SCALE_STATUTE MILES
0
10
20
30
40
PANOLA
BOLIVAR
TALLAHATCHIE
WASHINGTON
HOLMES
YAZOO
HINDS
SIMPSON
JEFFERSON
COVINGTON
JONES
WAYNE
MONROE
STONE
HARRISON
GREENE
GEORGE

Figure 1. Soil areas of Mississippi

ness, and would be willing to keep the necessary records.

The enterprise organization of each farm was studied by means of the 1944 farm plan sheets made available by the several county AAA officers. Farms were then divided into three groups determined by the emphasis placed on the production of milk and cotton, and farm types were so designated. Farms with a large number of cows compared with the number of acres in cotton comprised one group, or **dairy-cotton** farms. A few farms in this group did not grow cotton after having planned to do so. Where the number of acres of cotton was large in proportion to the number of cows, the farm type was designated **cotton-dairy**. The farms having about the same number of cows as acres of cotton constituted the third type, or **dairy & cotton.** Of the 40 farms keeping records, 16 were dairy-cotton, 12 cotton-dairy, and 12 dairy & cotton. This manner of grouping was selected in order that comparisons could be made relative to cost factors and income for the various farm enterprises under different organization conditions.

Operators of the farms thus selected were interviewed on their farms where consent was obtained to keep the necessary records. The supervision of the keeping of the records was done by a member of the Experiment Station staff, and each farm was visited once every 4 weeks.

Description of Farms Studied

Land Utilization

The average amount of land per farm for the 40 farms was 170 acres (Table 1). Cropland accounted for 75 acres per farm, or 44 percent of total land. Open, tillable pasture land amounted to 43 acres per farm, representing 25 percent of all land; and open non-tillable pasture land amounted to 21 acres, or 12 percent. Thus, 81 percent of all land was open land. Woods pastured accounted for 8 percent of the land per farm; woods not pastured, 5 percent; and the other land used for miscellaneous purposes, 5 percent. It will be noted that pasture land of all kinds amounted to 88 acres, or slightly more than one-half of the total average acreage per farm.

On farms where cotton was the major enterprise, 55 percent of the land was cropland. Where dairy cows were the major enterprise, 30 percent of the land was cropland; and where the two enterprises ranked about the same, 42 percent of the land was devoted to crops. It will be noted that where major emphasis was placed on dairy cows, slightly more than half of the total land was devoted to open pasture. Where cotton received major emphasis, only 30 percent of the farm acreage was used for open pasture land.

Crop Acres

On the average, more acres of land were devoted to corn than to cotton. Corn and cotton acreages were about the same on cotton-dairy farms. Hay constituted the largest acreage of any crop (table 2). Other than cotton, cash crops were relatively unimportant on most farms. Two farms produced hay for sale and one raised watermelons and cantaloupes for the market. It will be noted that less than one-half acre per farm was used for growing silage crops. Only six farmers grew silage. These six farms grew an average of 2 acres per farm.

On farms where dairying was the major enterprise, 74 percent of the acres cropped was devoted to feed crops; on cotton-dairy farms, 69 percent; and on dairy & cotton farms, 69 percent. Acres of oats per farm averaged 6.8. However, only 14 of the 40 farms actually growing oats had an average of 19.4 acres per farm.

Hay was an important crop on most of the farms. Johnson grass predominated in the Northeast Prairie Area, but in

Table 1. Use of land on 40 farms and on different types of farms in Northeast Mississippi, 1944.

Land use	Average number of acres							
	40 farms		Dairy-cotton		Cotton-dairy		Dairy & cotton	
	Per farm	Pct. of total	Per farm	Pct. of total	Per farm	Pct. of total	Per farm	Pct. of total
Cropland	75	44.1	44	29.9	140	55.3	50	41.9
Open pasture, tillable	43	25.3	48	33.0	47	18.7	33	27.4
Open pasture, not tillable	21	12.4	27	18.4	28	11.0	8	6.5
Woods pastured	14	8.2	18	12.5	11	4.3	11	9.2
Woods not pastured	9	5.3	5	3.3	14	5.4	12	10.1
Other land	8	4.7	4	2.9	13	5.3	6	4.9
Total	170	100.0	146	100.0	253	100.0	120	100.0

Table 2. Crop acres on 40 farms and on different types of farms in Northeast Mississippi, 1944.

Crop	40 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton	Number of farms growing crops
	Acres per farm	Acres per farm	Acres per farm	Acres per farm	
Cotton	17.2	4.4	39.9	12.1	32
Corn	21.8	12.2	39.4	16.9	37
Oats	6.8	5.5	8.0	7.3	14
Soybeans (seed)	.2	—	—	.5	1
Lespedeza (seed)	.1	—	—	.3	1
Johnson grass hay	10.7	5.6	28.2	—	8
Lespedeza hay	2.4	3.8	2.1	.9	11
Soybean hay	8.3	5.8	15.7	4.5	21
Other hay	5.2	3.8	4.6	7.5	18
Total hay	26.6	19.0	50.6	12.9	—
Sorghum, silage	.4	.5	.2	.6	6
Sorghum, syrup	.1	—	—	.3	3
Truck and garden	.7	.4	1.5	.5	40
Other crops	1.5	.1	2.0	2.2	—
Crop acres[1]	75.4	42.1	141.6	53.6	—
Double crop acres[2]	3.0	2.4	6.7	5.1	—
Land cropped	72.4	39.7	134.9	48.5	—
Idle	2.7	4.3	5.1	1.6	—
Total cropland	75.1	44.0	140.0	50.1	—

[1] Crop acres—Total acres of crops, includes double cropping.

[2] Double-cropping acres are included in the above crop acreages.

Table 3. Classes of livestock and their values on 40 farms in Northeast Mississippi, 1944.

Class	Number per farm	Value per farm	Percent of total
Dairy cows	14.2[1]	$981	47.3
Other cattle	10.9	399	19.2
Hogs	9.1	106	5.1
Hens	80.0	84	4.1
Workstock	4.4	497	23.9
Other[2]	2.4	9	.4
Total	—	2076	100.0

[1] Average for 5 inventories during the year.

[2] Average for 39 farms.

the Pontotoc Ridge and Northeast Highland Areas, soybean acreage for hay was greatest. Lespedeza was next in importance. A considerable number of farms interplanted corn with soybeans and harvested the plants for hay or stocked them down. Most of the farmers growing soybean hay, ground it before feeding it to dairy cows and other livestock.

Classes of Livestock

Dairy cows were the most numerous livestock on the average farm (table 3).

The average number of dairy cows per farm was 14, with a total value of $981 per farm, or an average value of $69 per cow. Milk cows constituted 47.3 percent of the total farm investment in livestock. The range in number of dairy cows for all farms was from 4 to 40. Only two farms milked less than 6 cows; 4 less than 7 cows; and 10 less than 10 cows. Nine farms milked 20 or more cows. Nineteen herds averaged 4,000 pounds per cow or more, and 8 had an average production of more than 5,000 pounds of milk per year. The range in the amount of milk produced per cow per year was from 2,200 pounds to 5,800 pounds with 4 herds producing less than 3,000 pounds per cow.

Farm Investment

The investment per farm amounted to $10,743 (table 4). Cotton-dairy farms had the largest investment, as might be expected on account of larger cropland requirements. Dairy-cotton and dairy & cotton farms were more nearly equal in real estate investment and total investment.

The average investment in real estate for the 40 farms was 60.2 percent. On cotton-dairy farms the investment in real estate was 68 percent, while dairy-cotton and dairy & cotton farms had a real estate investment of 52.5 and 56.1 percent, respectively. Investment in livestock was lowest on cotton-dairy farms. The relative investments in feeds and equipment were about the same.

Farm Receipts and Expenses

Farm receipts are the total income from farm sources. They include money received or due from the sale of the current year's crops, sale of livestock and livestock products, sale of equipment and

Table 4. Average farm capital per farm for 40 farms and by types of farms in Northeast Mississippi, 1944.

Item	40 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton	Per acre 40 farms
	dollars	dollars	dollars	dollars	dollars
Land	4,073	2,422	7,712	2,635	23.96
Buildings	2,257	2,116	3,022	1,680	13.28
Fences	136	153	142	107	.80
Total real estate	6,466	4,691	10,876	4,422	38.04
Livestock	2,076	2,336	2,025	1,778	12.21
Equipment	1,039	986	1,436	713	6.11
Feeds	1,029	849	1,429	868	6.05
Miscellaneous supplies	133	87	236	95	.79
Total	10,743	8,949	16,002	7,876	63.20

Table 5. Financial summary for 40 farms and by types of farms in Northeast Mississippi, 1944.

Item	40 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton
	dollars	dollars	dollars	dollars
1. Farm investment	10,743	8,949	16,002	7,876
2. Farm receipts	5,930	5,145	8,334	4,573
3. Farm expenses	3,973	3,298	6,106	2,740
4. Farm income (2 minus 3)	1,957	1,847	2,228	1,833
5. Interest on investment at 5 percent	537	447	802	394
6. Labor income (4 minus 5)	1,420	1,400	1,426	1,439
7. Farm privileges	590	623	576	560
8. Labor earnings (6 plus 7)	2,010	2,023	2,002	1,999
9. Value operator's time*	557	557	557	557
10. Return on investment	1,400	1,290	1,671	1,276
11. Percent return on investment	13.0	14.4	10.4	16.2

*The operator's labor was valued at current wages for a hired man without meals and lodging for 12 months. Unpaid family labor was valued at the same rate.

supplies, and any increase in the inventory value of the farm property. Farm receipts for the 40 farms averaged $5,930 (see table 5).

Farm expenses represent the cost of operating the farm business, except for interest on investment and value of the operator's time. Farm expenses include all cash expenses for labor, feed, supplies, taxes, etc.; the value of unpaid family labor other than the operator's; the value of board furnished hired help; the cost of livestock and equipment purchased; and any decrease in the inventory value of farm property. Farm expenses, or farm business expenses, do not include family living expenses. The average farm expenses for 40 farms was $3,973.

Farm Returns

Farm income, which is farm receipts less farm expenses, amounted to $1,957 for the 40 farms as a whole. Deducting from farm income the amount of interest at 5 percent on the average investment, gives a labor income of $1,420. Labor earnings are found by combining labor income and contributions made by the farm to family living, such as house rent and foods. This amounted to $2,010 per farm.

Return on the average farm investment was $1,400 or 13 percent. The operator's time may have been undervalued. If that were true, the percentage return on investment would be less in proportion to the increase of the value of the operator's time.

Farm receipts and expenses for the different types of farms varied directly with the size of the investment. However, it will be noticed that labor income did not vary much from one type to another. Causes for these differences and similarities will be discussed in following sections of this study.

Costs and Returns for Milk Production

Milk was produced for sale on all farms. About 12 percent of all milk produced was used on the farm. Practically all of the remaining 88 percent was sold to cheese plants and condenseries. A few farmers sold their milk to wholesale distributors.

The average number of milk cows per farm was 14. (See table 6). Milk produced per farm amounted to 55,991 pounds, or 3,931 pounds per cow. The family used 3,861 pounds of milk, and the average farm fed 2,729 pounds of milk to calves.

Feed Costs

Feed was the largest item of cost in the production of milk. The feed cost per herd for one year on all farms averaged $1,109. Of this, concentrates amounted to $608; roughage, $372; and pasture, $129. This total feed cost amounted to 59.6 percent of total milk production costs. On a per cow basis, this feed cost per year was $78, and the feed cost to produce 100 pounds of milk was $1.98.

The amount of feed per cow varied considerably, and much of this variation was due to whether there was available suitable land for hay and pasture production in the three soils areas in Northeast Mississippi — Black Prairie, Northeast Highland, and Pontotoc Ridge. The five farms feeding the least concentrates averaged 642 pounds per cow. The five farms feeding the most concentrates averaged 2,898 pounds per cow. The five farms feeding the least roughage averaged 969 pounds per cow, and the five farms feeding the most roughage averaged 5,157 pounds per cow. The capacity of milk cows, the knowledge of farmers relative to desirable feeding standards, and high feed costs were other factors contributing to the wide variation in the amounts of feed fed on various farms.

When concentrates fed per cow were increased, milk produced per cow increased (table 7). On the other hand, when roughage per cow was increased, there was a slight decrease in the amount of

Table 6. Production, disposal and costs of and returns for milk on 40 farms in Northeast Mississippi, 1944.

Item	Average per herd	Average per cow: Amount	Average per cow: Value	Average 100 lbs. of milk	Proportion of total
Costs	dollars	hours or pounds	dollars	dollars	percent
Feeds:					
Concentrates	608.37	1,516	42.71	1.09	32.7
Roughages	371.72	2,624	26.09	.66	20.0
Pasture	129.12	—	9.06	.23	6.9
Total feed	1,109.21	—	77.86	1.98	59.6
Man labor	507.35	145	35.62	.90	27.3
Horse labor	.15	—	.01	.00	.0
Buildings	34.47	—	2.42	.06	1.9
Equipment	18.05	—	1.27	.03	1.0
Depreciation on cows	82.71	—	5.81	.15	4.4
Interest	48.75	—	3.42	.09	2.6
Miscellaneous	59.83	—	4.20	.11	3.2
Gross farm costs	1,860.52	—	130.61	3.32	100.0
Credits:					
Manure	108.35	—	7.61	.19	—
Calves	28.82	—	2.02	.05	—
Total credits	137.17	—	9.63	.24	—
Net farm costs	1,723.35	—	120.98	3.08	—
Hauling charges	126.09	—	8.85	.25	—
Total costs	1,849.44	—	129.83	3.33	—
Milk returns:					
Milk sold	1,987.36	—	139.51	4.02	—
Milk used on farm	232.27	—	16.31	—	—
Total milk returns	2,219.63	—	155.82	—	—
Profit	370.19	—	25.99	.69[1]	—
Labor returns	877.54	—	61.61	1.59[1]	—

[1] Per 100 pounds sold.

Average number cows per herd	14	Milk produced per farm	55,991 lbs.
Average produced per cow	3,931	Milk sold per farm	49,401 lbs.
Pounds sold per cow	3,468	Personal use per farm	3,861 lbs.
		To calves per farm	2,729 lbs.

Table 7. Concentrates fed per cow related to various factors on 40 farms in Northeast Mississippi, 1944.

Concentrates per cow, pounds	Number of farms	Average concentrates per cow	Milk per cow	Cost per 100 lbs. milk	Roughage per cow
		pounds	pounds	dollars	pounds
Less than 1,500	23	851	3,774	3.08	2,518
1,500-3,000	15	2,020	4,347	3.78	3,112
3,000 and over	2	3,297	5,150	3.25	1,609

Table 8. Roughage fed per cow related to various factors on 40 farms in Northeast Mississippi, 1944.

Roughage per cow, pounds	Number of farms	Average roughage per cow	Milk per cow	Cost per 100 lbs. milk	Concentrates per cow
		pounds	pounds	dollars	pounds
Less than 1,500	7	1,085	4,186	2.58	1,609
1,500-3,000	20	2,280	4,085	3.22	1,347
3,000 and over	13	4,202	3,946	3.95	1,404

milk produced (table 8). The cost to produce milk increased as the amount of both concentrates and roughage fed per cow was increased.

Concentrates fed during the year to cows on dairy-cotton farms amounted to $50.51 per cow, which was the highest value of the three types of farms (table 9). This could be expected on farms where farmers placed the most emphasis on the dairy enterprise. However, these same farms had the least roughage cost of $23.70 per cow, compared with $32.14 for cotton-dairy farms, and $24.66 for dairy & cotton farms. Total feed costs were the greatest on dairy-cotton farms, next on cotton-dairy, and least on dairy & cotton farms.

The five farms producing milk at lowest cost, fed $43.10 worth of feed per cow, and the five farms producing milk at the highest cost fed $96.34 worth of feed. Since cows on high cost farms produced only 3,230 pounds each, this would indicate that the farm operators were at-

Table 9. Production, disposal, costs and returns of milk per cow by types of farms in Northeast Mississippi, 1944.

Item	Average 40 farms	Type of farm: Dairy-cotton (16 farms)	Cotton-dairy (12 farms)	Dairy & cotton (12 farms)	Five low cost farms[1]	Five high cost farms[1]
No. farms	40	16	12	12	5	5
No. cows per farm	14	19	12	10	11	15
Lbs. milk per farm	3931	3993	3413	4392	4633	3230
Man hours per cow	145	148	158	124	124	179
Costs						
Feeds:						
Concentrates	$42.71	$50.51	$32.65	$36.02	$18.55	$41.39
Roughages	26.09	23.70	32.14	24.66	17.16	42.95
Pasture	9.06	7.62	13.39	7.42	7.39	12.00
Total feed	77.86	81.83	78.18	68.10	43.10	96.34
Man labor	35.62	33.32	41.83	33.77	31.63	42.63
Buildings	2.42	2.12	3.35	2.02	1.47	2.65
Equipment	1.27	1.64	.97	.73	.49	1.45
Depreciation on cows	5.81	2.88	7.64	10.59	8.16	12.51
Interest	3.42	3.45	3.13	3.69	3.00	3.17
Miscellaneous	4.20	3.82	5.03	4.14	1.96	4.88
Horse labor	.01	.02	—	—	—	—
Gross farm costs	130.61	129.08	140.13	123.05	89.81	163.63
Credits:						
Manure	7.61	7.63	7.67	7.46	7.49	7.57
Calves	2.02	1.56	2.52	2.54	2.17	2.47
Total credits	9.63	9.19	10.19	10.00	9.66	10.04
Net farm costs	120.98	119.89	129.94	113.05	80.15	153.59
Hauling charges	8.85	8.98	7.61	10.02	11.61	6.80
Total costs	129.83	128.87	137.55	123.07	91.76	160.39
Milk returns:						
Milk sold	$139.51	$151.05	$111.30	$145.30	$144.46	$114.84
Milk used on farm	16.31	13.62	19.03	19.47	24.44	12.87
Total milk returns	155.82	164.67	130.33	164.77	168.90	127.71
Profit	25.99	35.81	—7.22	41.70	77.14	—32.68
Labor returns	61.61	69.12	34.61	75.47	108.77	9.95

[1] The cost of producing 100 pounds of milk.

The cost of producing milk on dairy and cotton farms was lowest and profit per cow was highest. Dairy and cotton farms spent less for feeds, less than average for labor, and had the highest production per cow.

tempting to get high production out of cows of low efficiency.

Man Labor Costs

The cost of labor per herd was $507 (table 7). The average number of man hours spent on one cow per year was 145, and was valued at $35.62. This amounted to 91 cents per 100 pounds of milk produced. The labor cost range for 100 pounds of milk was from 46 cents to $1.65. The amount of labor used per cow for one year ranged from a low of 96 hours for the 10 lowest farms to a high of 209 hours per cow for the 10 farms requiring the greatest amount of labor. The average cost of labor per hour spent on milk cows on all 40 farms was 24.5 cents. The range for this man-hour cost was from 16.4 cents to 39.5 cents. In producing milk, man labor accounted for 27.3 percent of the gross farm cost to produce 100 pounds of milk. Consequently the efficient use of labor is an important factor in producing milk economically.

Profit

Total milk returns per herd amounted to $2,219. Net farm costs per herd plus hauling charges amounted to $1,849. Thus the profit per herd was $370 and per cow, $25.99. The profit per 100 pounds of milk was the average price received ($4.02) less the total cost per 100 pounds ($3.33), and amounted to $0.69.

Labor Return

Assuming that profit on the enterprise is also a return to labor, the total return to labor would be profit on the enterprise plus man labor charges to the enterprise. The sum of $370 (profit) and $507 (labor charges) gives a labor return of $877. This amounts to $61.61 per cow, and $1.59 per 100 pounds of milk sold.

Much of the labor used on the farms in this study was unpaid family labor. Oftentimes this labor may be used on an enterprise when the cost of production is relatively high, particularly where it is convenient to engage in that enterprise, and still receive income that adds to the well-being of the farmer and his family. In case of the dairy enterprise, the farmer charges the cows with grain, hay, and other feeds at farm value (market value less transportation costs) instead of what they actually cost. Consequently, an enterprise may show a loss when its physical input costs are charged at farm value, yet the farmer can afford to go right along producing the enterprise and will be better off by doing so unless some alternative enterprise opportunity appears whereby he can get more for his input costs or values.

Of the 10 farms that made minus incomes on dairy cows, only 3 made a minus labor return per cow. One farmer lost $31 per cow, but his labor return per cow was $30 and the labor per hour spent producing milk was $0.17. Another farmer had a loss of $4 per cow, yet his labor return per cow was $51 and the return per hour spent on milk cows was $0.32. If profit and loss had been computed on the basis of actual costs of producing feed on the farm, the return for labor would have been considerably more. Therefore, if a farmer receives the cost of production for 100 pounds of milk or a hundred pounds of cotton, that price includes the current wage rate for his labor and for all unpaid famliy labor. However, farmers are entitled to a fair profit above actual costs, as is expected in any other business, in order that they build up reserves for depression periods and for old age.

Costs and Returns per Cow on Different Type Farms

A study of table 10 shows costs and returns for the dairy enterprise by types of farming on a per cow basis. The average costs and returns per cow for the 40 farms is repeated for comparative purposes.

The annual net cost to keep a cow for one year on dairy-cotton farms amounted to $120. The costs on cotton-dairy farms were $130, and $113 on dairy & cotton farms. The annual profit per cow was $36 for dairy-cotton farms. There was a loss of $7 per cow for cotton-dairy farms, and a gain of $42 on dairy & cotton farms. It will be noticed that the profit was considerably greater on the farms where there was balanced emphasis on milk cows and cotton. Also, it will be noticed that cows on the dairy & cotton farms produced an average of 4,392 pounds of milk. That was a production of 400 pounds per cow above the dairy-cotton farms, and 1,000 pounds more than on cotton-dairy farms. Feed costs and net farm costs per cow were less than on the other two types of farms.

The differences between farm types pointed out in the preceding paragraph are favorable to those farmers who placed about the same emphasis on both cotton and milk cows in their farm program. Since, dairy & cotton farms used fewer man hours per cow, spent less for feed, and got a higher production from their cows, it would seem that their cows were more profitable because labor was used more efficiently and their cows were more efficient in converting feeds into milk.

Labor returns per cow were likewise greater on dairy & cotton farms. This return was 118 percent greater, or more than twice as great as the labor return on farms where emphasis was placed mainly on cotton. It was, however, only 9 percent greater than labor return per cow on farms placing major emphasis on the dairy enterprise.

Cotton Production Costs and Returns

Cotton was produced on 32 of the 40 farms on which records were kept. An average of 21.8 acres of cotton was produced on each farm. Actual bales ginned per farm was 20.2 or nearly one bale per acre. The number of 500-pound bales produced per farm was 21.3. The average price received per pound of lint cotton for all farms was 21.21 cents, and the cost to produce one pound of lint was 13.28 cents.

Man Labor

Man labor was the largest item of cost in producing cotton (table 10). The total man-labor cost for the average cotton enterprise on 32 farms in Northeast Mississippi was $1,089. This labor cost was $50 per acre of cotton grown, $51 per 500-pound bale and seed, and $40 per 500 pounds of lint. Man-labor cost per pound of lint was 8.04 cents, which constituted 60.5 percent of the total cost to produce one pound. Consequently, any steps taken by farmers to reduce the cost of producing cotton will necessarily include the consideration of man labor.

The man labor required to grow an acre of cotton amounted to 141 hours, and only 3 hours more were required to produce a 500-pound bale since produ tion was so near one bale per acre. The range in hours required per acre of cotton on the 32 farms was from 63 to 176. Barring the fact that there were differences in yield per acre among farms, there still would be much room for increasing the efficiency of labor. And since this cost item is 60.5 percent of the total cost of production, farmers could well look to using available labor on the farm, as well as hired labor, to a more distinctive advantage.

Total Costs of Producing Cotton

The average cost of producing the cotton enterprise on each of the 32 farms was $1,800, which amounted to $83 per acre. (See table 10). The cost to produce 500 pounds of lint was $66, which gave a cost of 13.28 cents per pound for lint cotton. This return from one acre of cotton for lint and seed was $104 and $17.57, respectively. The total return from the enterprise per farm was $2,646, thereby leaving a profit of $846 for the cotton enterprise and $38.90 per acre pro-

Table 10. Production, values, and average costs and returns per farm for cotton on 32 farms in Northeast Mississippi, 1944.

	Production:	Values: (Dollars received)
Cotton acres 21.77	Total seed cotton 26,109 lbs.	Total seed cotton 2,646.14
Bales ginned 20.23	Total lint 10.671 lbs.	Total lint 2,263.72
Man hours per acre 141	Total seed 15,438 lbs.	Lint per pound 0.2121
	500 lb. bales 21.34 lbs.	Total seed 382.42

Item	Total crop	One acre seed cotton	One 500-lb. bale and seed	500 lbs. of lint*	Total seed	Total lint*	Lint Per lb.*	 Percent of total
	dollars	dollars	dollars	dollars	dollars	dollars	cents	percent
Costs:								
Land	67	3.08	3.14	2.47	53	14	0.50	3.7
Fertilizer	107	4.92	5.01	3.95	84	23	0.79	6.0
Manure	38	1.76	1.80	1.42	30	8	0.28	2.1
Seed	43	1.97	2.01	1.59	34	9	0.32	2.4
Man labor	1,089	50.02	51.02	40.18	857	231	8.04	60.5
Horse labor	195	8.95	9.13	7.19	153	41	1.42	10.8
Tractor	22	1.01	1.02	.81	17	5	0.16	1.2
Other equipment	54	2.48	2.53	1.99	43	12	0.40	3.0
Ginning	108	4.96	5.06	3.98	85	23	0.80	6.0
Miscellaneous	77	3.53	3.60	2.84	61	16	0.57	4.3
Total costs	1,800	82.68	84.32	66.40	1,417	382	13.28	100.0
Returns:								
Total lint	2,264	104.01	106.07	—	—	—	—	—
Total seed	382	17.57	17.92	—	—	—	--	—
Total	2,646	121.58	123.99	106.07	2,264	382	21.21	—
Gain	846	38.90	39.67	39.67	846	0	7.93	—

*Cost of lint cotton is determined by the total costs of seed cotton minus total value (amount received) of seed.

Table 11. Acres in cotton, bales produced, and the costs and returns per acre for cotton on 32 farms in Northeast Mississippi, 1944.

Items	Average	Dairy-cotton	Cotton-dairy	Dairy and cotton	Five low-cost farms[1]	Five high cost farms[1]
Number of farms	32	8	12	12	—	—
Acres in cotton	21.8	9.1	39.9	12.1	12.10	13.90
500 lb. bales produced	21.3	6.0	40.3	12.6	13.83	10.77
500 lb. bales per acre	.98	.67	1.01	1.04	1.14	.78
Man hours per acre	141	112	151	120	113	122
Costs:						
Land	$3.08	$3.37	$3.19	$2.59	$3.26	$2.42
Fertilizer	4.92	2.39	5.32	4.83	5.33	4.61
Manure	1.76	3.03	.91	3.92	2.01	4.10
Seed	1.97	2.30	1.66	2.85	2.63	2.05
Man labor	50.02	28.15	53.68	48.89	37.42	44.55
Horse labor	8.95	7.88	9.18	8.71	6.23	9.95
Tractor	1.01	.62	1.08	.94	1.20	1.71
Other equipment	2.48	3.62	2.31	2.46	2.01	2.13
Ginning	4.96	3.56	5.05	5.36	5.80	3.95
Miscellaneous	3.53	1.96	3.86	3.25	2.52	5.37
Total costs	$82.68	$56.88	$86.24	$83.80	$68.41	$80.84
Cost per pound of lint, cents	13.28	13.31	13.55	12.42	8.24	17.17
Returns:						
Lint	$104.01	$17.27	$106.42	$112.38	$122.11	$84.94
Seed	17.57	12.44	17.86	19.16	21.32	14.28
Total returns	121.58	83.71	124.28	131.54	143.43	99.22
Profit	38.90	26.83	38.04	47.74	75.02	18.38
Labor return per acre	88.92	54.98	91.72	96.63	112.44	62.93

[1] Based on cost per pound of lint.

duced. With a cost per pound of lint at 13.28 cents and an average price of 21.21 cents received per pound, this gave a profit of 7.93 cents per pound of lint to the farmers growing cotton.

Costs of Cotton Production on Different Type Farms

There was much variation in the acreage devoted to cotton production on the three types of farms (table 11). The range was from 9.1 acres per farm on dairy-cotton farms to 39.9 acres on cotton-dairy farms. Dairy & cotton farms produced 12.1 acres, which was only 3 acres more than was produced on dairy-cotton farms, and less than one-third of the acres grown on cotton-dairy farms. The number of acres produced on the five low-cost farms and the five high-cost farms was about the same, and approximately the same as was produced on dairy & cotton farms.

The items of cost in the production of cotton varied considerably in value for the three types of farms. Man labor per acre, the most important cost item, was least on dairy-cotton farms and the most on cotton-dairy farms, $28 and $54 respectively. This cost was $49 per acre on dairy & cotton farms. Horse labor costs followed the same pattern. The low cost of man labor to produce an acre of cotton on dairy-cotton farms probably was due more to the smaller yield of cotton per acre than to more efficient use of labor on dairy & cotton farms.

Fertilizer costs varied from $2.39 per acre on dairy-cotton farms to $5.32 on cotton-dairy farms. The five farms producing cotton at the least cost per pound used $5.33 worth of fertilizer per acre. The total cost of producing a pound of lint on the three types of farms did not vary much, but was least on dairy & cotton farms. (See table 12.) It will be seen that the cost of production per pound on the five low cost farms was only 8.24 cents, while on the five high cost farms, the cost to produce one pound of lint was 17.17 cents.

Cotton Returns on Different Type Farms

Total returns per acre of cotton was the smallest on dairy-cotton farms. (See table 12.) This is largely the reflection of a low yield per acre for this type of farming. The average return per acre for all types was $122; for dairy-cotton, $84; for cotton-dairy, $124; and for dairy & cotton, $132. Profits per acre were $39, $27, $38, and $48, respectively. The five farms producing cotton at the lowest cost per pound—8.24 cents—had a profit of $75 per acre, whereas $18.38 was the profit per acre on the five farms producing cotton at the highest cost per pound, which was 17.17 cents.

Considering returns and profits as a whole, it appears that the yield per acre was the most important factor determining the cost to produce a pound of cotton and the return the farmer got for his labor.

Costs and Returns for Other Enterprises

Costs and Returns on Corn

Thirty-seven of the 40 farms keeping records produced corn. Acres per farm averaged 25.3 and the production per acre was 23.3 bushels. On the average, 27.8 man hours and 26.7 horse hours of labor were required per acre.

The total average cost per farm for the corn enterprise was $563, or $22.23 per acre. (See table 12). With a production of 23.3 bushels per acre, this resulted in a cost of 95.5 cents per bushel. Again, as can be seen, the largest item of cost was labor. Man labor cost amounted to 35 percent of the total cost to produce a bushel of corn. Horse labor accounted for 28.3 percent. It will be recalled that the proportionate part of the total cost to produce one pound of cotton was 60.5 percent for man labor and 10.8 percent

Table 12. Costs and returns for corn on 37 farms in Northeast Mississippi, 1944.

Item	Quantity per acre	Value per farm	Value per acre	Per bushel	
				Value	Percent of total
		dollars	dollars	cents	percent
Costs:					
Land	—	81.39	3.21	13.8	14.5
Fertilizer	—	20.95	0.83	3.5	3.7
Manure	—	7.69	0.30	1.3	1.4
Seed	—	9.54	0.38	1.6	1.7
Man labor	27.8 hrs.	197.07	7.78	33.4	35.0
Horse labor	26.7 hrs.	159.18	6.29	27.0	28.3
Tractor	3.5 hrs.	41.62	1.64	7.0	7.4
Other equipment	—	28.92	1.14	4.9	5.1
Miscellaneous	—	16.68	0.66	2.8	2.9
Total costs	—	563.06	22.23	95.5	100.0
Returns:					
Corn	23.3 bu.	714.00	28.19	121.0	—
Profit	—	150.94	5.96	25.5	—

Acres per farm	25.3	Cost per bushel	$0.96
Return per hour of labor	$0.49	Value per bushel	$1.21

for horse labor. In the case of corn, horse labor has assumed a larger part of the cost. Again it will be noticed that the land cost to produce a bushel of corn was 13.8 cents. This amounts to 14.5 percent of the total cost to produce a bushel of corn, whereas the land cost to produce a pound of cotton was 0.5 cent, or 3.7 percent of the total cost to produce a pound.

The total return per farm from the corn enterprise was $714, or $28.19 per acre. The average farm value per bushel was $1.25. With a cost of 95.5 cents per bushel, this gave the farmers a profit of $151 for the corn enterprise, $5.96 per acre, and 25.5 cents per bushel. The labor return per hour spent on corn was $0.49.

Costs and Returns for Hogs

Thirty-eight of the 40 farms produced hogs. Only a few farmers produced for the market. Sales by others were for the purpose of disposing of a small surplus produced.

It cost $12.41 gross to produce 100 pounds of live pork. Of this amount 83.5 percent was for feed. On an average, 306 pounds of corn valued at $7.54, 82 pounds of other feed valued at $2.66, and pasture valued at 16 cents constituted the kinds, amounts, and values of feeds fed to produce this 100 pounds of live pork. It required 5.8 hours of man labor per 100 pounds of pork valued at $1.46 which represented 11.8 percent of the total cost to produce 100 pounds of pork.

Considering credits of manure and miscellaneous credits which amounted to $0.38 per 100 pounds, the net cost to produce 100 pounds was $12.03. The value per 100 pounds of live pork produced was $12.53, which left a profit of $0.50 per 100 pounds. This small profit on producing hogs was due to the unfavorable hog-corn ratio in Northeast Mississippi in 1944.

Workstock Costs

Workstock was used on all farms and there was an average of 4.3 head per farm. Each head of workstock worked 462 hours, or 46 work days of 10 hours each during the year. The average cost for all farms was 22.9 cents per hour.

Feed amounted to $88 per head which was 78.1 percent of total costs. Two thousand seventy-six pounds of concentrates, principally corn, were fed per head at a cost of $52. Roughage fed per head amounted to 2,263 pounds valued at $30. Pasture was charged at actual cost or $6.47 per head. Man labor to care for one head of workstock for a year was 35.8 hours, which cost $9.89. Costs other than feed and man labor amounted to $14.95. A manure credit of $7.50 per head was deducted from total gross costs per head of $113, which resulted in a net cost of $106 to keep one head of workstock for a year.

Since workstock worked only 46 days per head during the year, some attention should be given to utilizing workstock labor more efficiently.

Factors That Affect Costs and Returns

Size of Business

Size is an important factor that affects all business enterprise and particularly is this true of farming. Farm income and the family standard of living are largely determined by this factor. The size of a farm business can be measured in several ways. Number of acres operated, capital investment, crop acres, amount of labor used, number of units comprising the major enterprises such as acres of cotton, number of milk cows in the herd, are measures commonly used. The more desirable measure to use in determining the size of a farm business depends a great deal on the type of farming followed.

Some of the measures used to show the size of the 40 farm businesses are shown in table 13. Acres per farm for all farms averaged 170, with a total investment of $10,743. Cotton-dairy farms had more total acres, cotton acres, crop acres, and a larger investment than the dairy-cotton or dairy & cotton farms. This could be expected since emphasis was placed on cropping. As a whole, cotton-dairy businesses were the largest, dairy-cotton farms next, and the dairy & cotton farms the smallest.

When considering the size of business in the Northeast Prairie, Northeast Highland, and Pontotoc Ridge Soil Areas, it will be noticed that the Prairie farms ranked highest in all measures (table 13). The Northeast Highland Area was next in all measures and the Pontotoc Ridge Area was the lowest in all measures.

Man work units. Since man labor is a common denominator of all farms, table 14 was constructed to show the relation of man work units per farm to and among other important factors. As the man work units (10 hours of production from work performed by one man) per farm increased, the number of cows increased, acres of cotton increased very pronouncedly, and labor income increased.

Acres of cotton. Acres of cotton per farm varied considerably. (See table 15.)

Labor requirements increased per 500-pound bale produced as the acres of cotton per farm increased on farms that grew more than 10 acres. Under increasing mechanization conditions the reverse of this relationship would be expected. However, practically all of the cotton production on the 32 farms was performed by man and horse labor. Thus it would appear that labor is being used less efficiently on the larger farms. The same relationship exists when considering cotton-dairy farms alone.

Larger farms have more cropper tenants, and according to data presented in table 15, such labor is not as efficient as the labor furnished by the operator, members of his family, and the small amount of labor hired during the year on the smaller farms. Labor income increases as the size of the cotton enterprise increases, but labor income does not necessarily reflect efficient use of cropper labor on farms when considering the size of the business.

Labor Efficiency

Using labor to the best advantage is one of the most important problems with

Table 13. Size of farm business by type of farms and in major soil areas of Northeast Mississippi, 1944.

		Type of farm			Soil area		
Item	All farms	Dairy-cotton	Cotton-dairy	Dairy & cotton	N. E. Prairie	N. E. Highland	Pontotoc Ridge
		Average per farm					
Number of cows	14	19	12	10	17	13	7
Acres of cotton	21.8	9.1	39.9	12.1	29	14	11
Crop acres	75.4	42.1	141.6	53.6	94	54	49
Total acres operated	170.0	146.0	253.0	120.0	206	141	109
Total man work units	494	508	594	377	561	442	373
Investment	$10,743	$8,949	$16,002	$7,876	$12,800	$9,083	$7,871

Table 14. Man work units related to various factors on 40 farms in Northeast Mississippi, 1944.

Man work units per farm	Number farms	Work units per farm	Milk cows	Acres of cotton	Labor income
Below 300	6	270	11	10.0	$1,097
300 - 499	15	380	10	14.8	1,289
500 - 699	15	584	18	20.6	1,325
700 - 899	2	748	19	38.0	2,492
900 and over	2	1,099	28	84.0	3,016
Total	40	494	14	21.8	1,419

Table 15. Acres of cotton per farm related to labor requirements and returns on 32 farms in Northeast Mississippi, 1944.

Acres of cotton	Number farms	Acres per farm	Man hours per 500 lb. bale	Labor income
Below 10.0	9	6.1	152	$1,169
10 - 19.9	11	14.1	120	1,532
20 - 29.9	6	23.7	125	1,622
30 and over	6	57.5	158	1,906

Table 16. Man hours per cow related to various factors on 40 farms in Northeast Mississippi, 1944.

Man hours per cow	Number farms	Hours per cow	Milk per cow	Cost per 100 lbs. milk	Labor returns per hour
		hours	pounds	dollars	dollars
Less than 100	5	86	3,920	2.81	0.73
100 - 149	19	125	4,332	3.07	0.56
150 - 199	12	167	3,575	3.70	0.30
200 and over	4	262	4,385	4.27	0.18
Total	40	145	3,931	3.34	0.47

which farm operators deal. Labor requirements are much greater for some enterprises than for others, and at the same time, the demands on all farms for labor is highly seasonal, particularly for crops. Labor requirements for crops constitute the largest cost item in their production. For cotton, this cost amounts to 60.5 percent of the total expenses of growing the crop. Labor requirements for corn, hay, and other crops were somewhat less, but still were the highest single cost item.

Man hours per cow. The amount of labor used per cow ranged from 86 hours to 262 hours, and the average amount of man labor per cow was 145 hours for the 40 farms. (See table 16.) There was practically no relationship between hours used per cow and the amount of milk produced per cow. However, as man hours expended per cow increased, the cost to produce 100 pounds of milk increased, and the labor return per hour decreased. Thus the labor used per cow should be kept at a minimum in keeping with the ability of the cow to produce milk.

Man hours per acre of cotton. The labor used per acre of cotton varied very much also. Seven farms averaged only

77 man hours per acre while a like number of farms averaged 168 hours. As the man hours per acre increased, the pounds of cotton produced per acre increased, which was unlike the relationship of labor expended per cow and the milk produced per cow. However, as the pounds of cotton per acre and labor per acre increased, the cost to produce an acre of cotton increased. Unlike the application of labor to cows, as labor on cotton per acre increased, the cost to produce one pound of lint decreased and the labor return per hour increased up to 150 hours per acre and then decreased. Consequently, a farmer should be very careful about increasing the hours of labor used per cow and the labor used per acre of cotton above 150 hours under conditions similar to those on the 40 farms in Northeast Mississippi.

Rates of Production

Types of farming and rates of production. Farms placing the most emphasis on cotton (cotton-dairy farms) kept cows which had the lowest production, or 3,400 pounds each (table 17). Farms where major emphasis was placed on the dairy enterprise (dairy-cotton farms) kept cows that produced an average of 4,000 pounds each. And farms which placed about the same emphasis on both dairy and cotton enterprises kept milk cows that produced an average of 4,400 pounds of milk each.

There was little relationship between the amount of milk produced per cow and the size of herd or the amount of concentrates fed per cow. Roughages fed per cow decreased as milk production increased and labor used per cow followed the same trend. It will be noticed that where there was a balance between number of cows and acres of cotton per farm that labor per cow was the lowest and milk production per cow was the highest. This made for more profitable milk production as shown in table 18.

The cost to keep a cow for one year decreased by types of farming as the production per cow increased among the types. Cost per cow was $148 on cotton-dairy farms, $138 on dairy-cotton farms, and $133 on dairy & cotton farms. Cost of producing 100 pounds of milk on dairy & cotton farms was the lowest, amounting to $2.83. The cost on dairy-cotton and cotton-dairy farms per 100 pounds of milk was $3.27 and $4.09, respectively. Farmers who placed major emphasis on producing cotton and minor

Table 17. Types of farming in Northeast Mississippi related to milk production per cow and other dairy factors on 40 farms, 1944.

Type of farming	Number of farms	Size of herd	Milk per cow	Feed per cow		Man hours per cow
				Concentrates	Roughages	
	No.	No.	lbs.	lbs.	lbs.	hrs.
Cotton-dairy	12	12	3,413	1,242	2,858	158
Dairy-cotton	16	19	3,993	1,737	2,637	148
Dairy & cotton	12	10	4,392	1,314	2,319	124
All types	40	14	3,931	1,516	2,624	145

Table 18. Types of farming in Northeast Mississippi related to milk production per cow, costs and returns on 40 farms in Northeast Mississippi, 1944.

Type of farming	Number of farms	Milk per cow	Cost of feed and pasture per cow	Cost per cow per year	Cost of 100 lbs. milk	Profit per cow	Labor returns per hour on cows
		lbs.	dollars	dollars	dollars	dollars	dollars
Cotton-dairy	12	3,413	78	148	4.09	—7	0.22
Dairy-cotton	16	3,993	82	138	3.27	36	0.47
Dairy & cotton	12	4,392	68	133	2.83	42	0.61
All types	40	3,931	78	139	3.34	26	0.42

Table 19. Milk produced per cow related to various factors on 40 farms in Northeast Mississippi, 1944.

Pounds per cow	Number farms	Milk per cow	Feed cost per cow	Cost per 100 lbs. milk	Profit per cow	Labor return per cow
		lbs.	dollars	dollars	dollars	dollars
Below 3,000	4	2,575	76	4.51	—15.75	14
3,000 - 3,999	17	3,529	64	3.33	12.94	51
4,000 - 4,999	11	4,409	81	3.13	42.91	78
5,000 - 5,999	8	5,438	100	3.11	44.13	85
Total	40	3,931	78	3.34	26.00	62

emphasis on producing milk lost an average of $7 per cow. Dairy-cotton farms made a profit of $36 per cow, and dairy & cotton farmers made $42 on each cow kept. Likewise, the return per hour for labor used on milk cows was highest on dairy & cotton farms, amounting to $0.61. Labor return per hour for this enterprise on dairy-cotton and cotton-dairy farms was $0.47 and $0.22, respectively.

Milk per cow. A study of the dairy enterprise on farms in Northeast Mississippi finds, as in similar studies elsewhere, that low producing cows are not profitable and that as production per cow increases, profits per cow increase.

Cows producing less than 3,000 pounds of milk per year showed a loss of $15.75 per year, whereas cows producing an average of 5,438 pounds netted the farmer $44. (See table 19.) Only four farms had cows producing below 3,000 pounds. The yearly cost to keep a cow increased as the amount of milk per cow increased. It cost $124 per year to keep a cow producing an average of 2,575 pounds, and it cost $175 to keep a cow that averaged 5,438 pounds. Thus the cost to produce approximately an extra 3,000 pounds of milk above the average production of the low producing cows was $51. That is the same as stating that farmers who kept cows that produced above 5,000 pounds, produced the last 3,000 pounds of milk at a cost of $1.70 per hundred.

Feed costs per cow increased as production increased, but the cost to produce 100 pounds of milk decreased. Profit per cow increased as production per cow increased. The cost to produce milk with a cow producing 5,000 pounds was 31 percent less than with a cow producing 2,500 pounds, and the labor return per cow was 500 percent greater for 5,500-pounds production cows.

Cost to produce 100 pounds of milk was $4.51 for farmers having cows that produced 2,575 pounds annually. Whereas, the cost was $3.11 per 100 pounds on farms having cows that averaged 5,438 pounds. Labor returns per hour spent on milk cows increased as the milk produced per cow increased. Again, it might be pointed out that though the farmers with the lowest producing cows made a minor profit per cow, they had a labor return of $14 per cow. Assuming the farmer could not use his labor more profitably on some other enterprise, and though his cows were low producers, his cows did pay all expenses other than labor and gave the farmer a return of $14 per head as part payment for the labor he spent on them during the year. Labor return per cow was $85 where cows averaged producing above 5,000 pounds of milk.

Pounds of cotton per acre. The production of cotton per acre ranged from 196 pounds to 837 when considering all farms. Seventy-five percent of all farms growing cotton had an average yield above 400 pounds per acre and 44 percent of the farms producing cotton had a yield above 500 pounds. (See table 20.)

As production per acre increased, man hours and total cost per acre increased.

Table 20. Pounds of lint per acre related to various factors on 38 farms in Northeast Mississippi, 1944.

Pounds of lint per acre	Number farms	Average pounds per acre	Man hours per acre	Total cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
		pounds	hours	dollars	cents	dollars	cents
Below 300	5	242	76	47	16.0	15	48
300 - 399	3	332	96	67	16.7	15	53
400 - 499	10	436	137	72	12.6	37	62
500 - 599	7	573	139	92	12.7	51	76
600 - 699	5	616	138	99	12.3	58	87
700 plus	2	798	161	114	10.9	83	93

Table 21. Types of farming related to various factors in producing cotton on 32 farms in Northeast Mississippi, 1944.

Type of farming	Acres per farm	Yield 500-lb. bales	Cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
	number	number	dollars	cents	dollars	cents
Dairy-cotton	9.1	6.1	57	13.3	27	49
Cotton-dairy	39.9	40.3	86	13.5	38	61
Dairy & cotton	12.1	12.6	84	12.4	48	81
All types	21.8	21.3	83	13.3	39	63

Likewise, profit per acre and labor return per hour increased. The farmers who produced above 770 pounds per acre received nearly one dollar per hour for their labor used on cotton.

Types of Farming

The yield of cotton per acre varied considerably on the 32 farms producing it. Table 21 shows this variation by types of farming. Cotton-dairy farms grew four times the average of cotton as was grown on dairy-cotton farms and a little more than three times the amount grown on dairy & cotton farms. The yield per acre was slightly more than a bale per acre on both cotton-dairy and dairy & cotton farms, whereas the yield was only two-thirds bale per acre on dairy-cotton farms.

The cost of producing a pound of cotton varied little between types of farms, but varied considerably between individual farms. The cost per pound on dairy-cotton and cotton-dairy farms was 13.3 and 13.5 cents, respectively. The cost to produce a pound of cotton on dairy & cotton farms was 12.4 cents, or one cent less than for the other farm types. The range in cost to produce a pound of cotton on the 32 farms was from 6.67 cents to 21.16 cents. Seventy-five percent of the farms produced cotton at a cost range from 10 to 16 cents per pound with an average cost of 13.3 cents for all farms.

Labor returns per hour spent on cotton averaged 63 cents for the 32 farms. Low yields per acre undoubtedly account for the low labor return on dairy-cotton farms. On the other hand, yields were approximately the same for cotton-dairy and dairy & cotton farms. Yet, the returns per hour of labor on dairy & cotton farms was 33 percent higher than on dairy-cotton farms. This difference was due largely to the fact that the cotton-dairy farms used 31 hours more labor per acre, or 26 percent more than was used by dairy & cotton farms.

Combination of Enterprises

The combination of crops and animal enterprises for 39 farms and for the three types of farming in Northeast Mississippi are shown in table 22. The most important crop enterprises were cotton, corn, and hay. Corn and hay were grown for livestock feed. Hay was a cash crop on

Table 22. Combination of enterprises by types of farming and as related to labor income on 39 farms in Northeast Mississippi.

Enterprise	Number farms reporting enterprise	Average for 39 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton
		Acres or head			
Crops:					
Cotton	32	13.8	4.4	30.0	12.1
Corn	37	19.5	12.2	33.0	16.9
Oats	14	5.6	5.5	3.7	7.3
Johnson grass hay	8	3.9	5.6	5.6	.0
Lespedeza, hay	11	2.4	3.8	2.1	.9
Soybeans, hay	21	8.0	5.8	15.7	4.5
Other hay	18	5.2	3.8	4.6	7.5
Total hay	—	19.5	19.0	28.0	12.9
Silage	6	0.4	0.5	0.6	0.6
Other crops	—	2.5	0.5	3.4	3.8
Crop acres[1]	—	61.3	42.1	98.7	53.6
Animals:					
Dairy cows	40	14	19.0	10	10
Other cattle	39	11	13	8	10
Hogs	34	9	8.0	9	9
Hens	40	80	53.0	116	84
Workstock	40	4	3.0	5	4

[1] Crop acres include double cropped acres.

two farms. Cotton and milk cows are the major income enterprises.

Generally, a farmer receives the most of his income from the farm enterprise on which he spends the most of his labor. The average farm had 14.2 milk cows, on which 205 ten-hour days of productive work were spent. Also, farms producing cotton had an average of 21.8 acres in that crop on which 307 ten-hour days of productive work were spent. Thus 49 percent more labor was used on the cotton enterprise than on the dairy enterprise for all farms.

All farms produced milk for the market. Only 32 farms produced cotton. Therefore, for eight farms, the sale of milk was the only source of cash income except for miscellaneous sales of surplus stock, eggs and feed, which contributed considerably to labor income on some farms. All of the farms sold surplus livestock such as calves and heifers, eggs, hens, hogs, and a few sold some hay and corn. Labor income for eight farms in the dairy-cotton farm group not producing cotton was 73 percent of average labor income for the entire group of dairy-cotton farms. In other words, farms including cotton in their farm program along with milk cows in this type of farming had a larger labor income. However, profit per herd on the eight farms depending on cows for their cash income was $883, or 33 percent above the average herd profit of $665 for dairy-cotton farms; and more than twice as much profit per herd as for the 40 farms, which was $370.

Type of farming related to enterprise profits. Farms placing major emphasis on cotton lost $7 per cow annually and $89 per herd. But they made a profit of $38 per acre on cotton and a profit of $1,516 on the cotton enterprise. (See table 23.) Farms placing about the same emphasis on both milk cows and cotton received the greatest return per cow and per acre of cotton. Labor income was slightly higher than for the other types of farming—dairy-cotton and cotton-dairy. Since the dairy & cotton farms were slightly smaller than dairy-cotton farms, and only about 50 percent as large

Table 23. Types of farming related to enterprise profits in Northeast Mississippi, 1944.

Type of farming	Profit on Dairy enterprise	Profit on Cotton enterprise	Profit per Milk per cow	Profit per Acre of cotton	Labor income
Dairy-cotton	$665	$ 246	$36	$27	$1,400
Cotton-dairy	—89	1,516	—7	38	1,426
Dairy & cotton	435	581	42	48	1,439
All farms	370	850	26	39	1,419

Table 24. Soil crop adaptation related to various factors on 40 farms in Northeast Mississippi, 1944.

Soil crop adaptation	Number farms	Lint cotton Per acre	Lint cotton Cost per pound	Corn Per acre	Corn Cost per bushel	Return per hour of labor on cotton	Labor income
		lbs.	cents	bu.	dols.	cents	dols.
Good	22	517	12.42	26	0.95	73	1,709
Fair	14	407	15.05	26	1.10	61	1,076
Poor	4	424	15.17	14	1.41	54	1,033

as cotton-dairy farms, it appears that much attention should be given to the desirability of organizing farms so that major emphasis is placed on both the cotton and dairy enterprises in the area of this study.

Weather conditions were very favorable in Northeast Mississippi to cotton production in 1944 and only fair for feed crops and pastures. These conditions should be considered when making an appraisal of the results of this report. The fact that cotton-dairy farms with a larger investment did not make a large labor income was due to the loss they sustained on their dairy herds and to using farm labor less efficiently.

Soil Crop Adaptation

Growing a crop on the type of soil to which it is best adapted usually gives the highest labor returns. Progressive farm operators give much thought to placing crops in their farm layouts so that this relationship exists. On 22 farms the adaptation of crops to soils on which they were grown was "good"; on 14 farms, "fair"; and on 4 farms it was "poor" (table 24.) The adaptation of crops to soils on the farm as a whole was used as a basis for the above classification.

The rate of production was highest where soil crop adaptation was good. It cost 12.42 cents to produce a pound of lint cotton where adaptation was good, 15.05 cents where it was fair, and 15.17 cents where adaptation was poor. The cost to produce a bushel of corn was 94 cents where soil crop adaptation was good, $1.10 where it was fair, and $1.41 where soil crop adaptation was poor. The cost of producing cotton per pound was 23 percent greater on farms with poor soil crop adaptation than on farms when the soil crop adaptation was good. It cost 50 percent more to produce corn on farms where the soil crop adaptation was poor than where the soil crop adaptation was good. Also, it will be observed that labor return per hour spent on cotton was 73 cents where soil crop adaptation was good, 61 cents where it was fair, and 54 cents on farms where it was poor. Labor income was highest on farms where soil crop adaptation was good and lowest on farms with poor soil crop adaptation.

Milk Production by Seasons

Seasonal fluctuation of the production of milk was tremendously great on a large majority of the farms. Since few farmers grow winter pastures and with many feeding lightly in the winter, milk production is piled up from April to September. In fact, 64 percent of the milk produced by 571 cows on 40 farms was produced from April to September.

This great fluctuation in milk production during the year affects very little the efficient operation of the farm business as they are now organized, since the labor spent on a cow varies only a small amount from season to season. On the other hand, milk processing plants are faced with a very difficult problem. Since their equipment, which represents a relatively large investment, is used only for processing whole milk, these plants are forced to carry equipment and labor necessary for capacity production for less than 6 months during the year and then operate much under capacity for a large portion of the year. Should the milk plants in the area shut down during their slack season, there would be no market outlet for farmers producing milk, which would be disastrous to the dairy business. Yet most dairy farmers permit their cows to virtually shut down in production during the winter months and expect milk plants running at one-fourth capacity or less to continue operation.

Seasonal production related to costs and returns. Thirteen farms milked cows that produced for sale during the months of January, February, and March, only 146 pounds each per month. That was less than ½ gallon daily per cow. For the 40 farmers as a whole, the average daily amount sold per cow in the months of January, February, and March was only 7.3 pounds of milk. That was less than 1 gallon per day. Cows producing above 5,000 pounds for sale during the year averaged 11.6 pounds of milk per day in the first quarter of the year and reached a production of slightly less than 2 gallons per day in the months of July, August, and September—their highest producing quarter. Milk sold per cow, on the average, was 1.3 pounds per day less than was produced. This amount was consumed by the family or by calves. Cows producing less than 5,000 pounds of milk sold per year reached their peak of daily production in the second quarter of the year.

The trend of milk sold monthly per cow in each of the quarters of the year, as well as the labor return per hour for labor used on milk cows is shown in figure 2. Increase in production for the second quarter of the year was rather abrupt. The increase for cows produced below 3,000 pounds sold annually was approximately 90 percent, and over 100 percent for cows producing from 3 to 4 thousand pounds. This increase in the springtime was not as great for cows above the 4,000-pound mark. It is shown further that production per cow declined gradually from the second quarter to the third quarter, except when more than 5,000 pounds were sold per cow, and then dropped precipitously in the fourth quarter, reversing the movement in the spring months.

Farm Practices

Practices followed in feeding cows varied from farm to farm giving varying results. Records of these methods of feeding show that the combination of feeds and the capacity of cows to convert feed materials into milk play a greater part in profitable milk production than do mere quantities of feed. A few farmers feed for winter production and many feed to keep their cows alive until spring grass comes. Others feed for winter production and then practically quit feeding when the cows begin to get a few nibbles of grass in the spring. A few dairymen are beginning to provide winter grazing by planting oats, or other winter crops. All indications point to the need for a more detailed study of feeding practices by dairymen under actual farm conditions.

Producing milk for the winter market. Farmers milking cows that have a relatively high production in the winter when compared with those having a low production in the winter months, produce milk more cheaply and receive the largest return per cow.

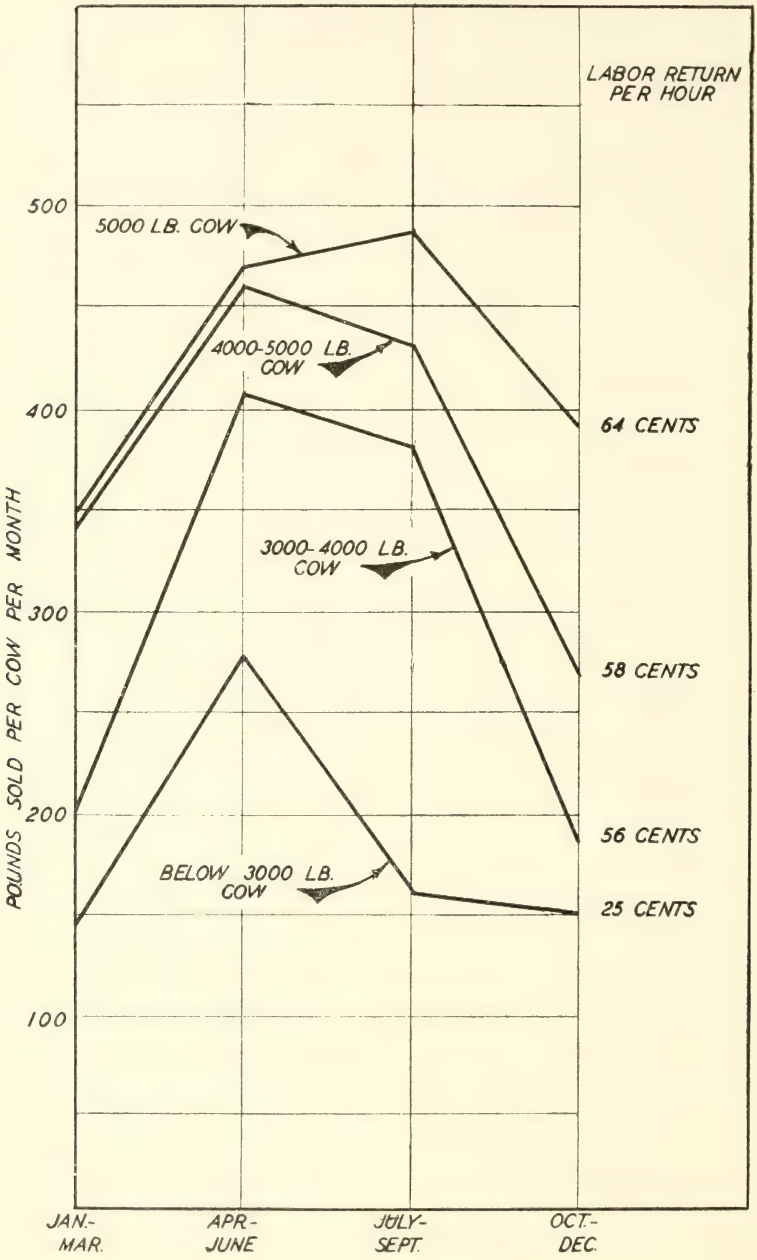

Figure 2. Pounds of milk sold monthly per cow in each quarter of year and labor return per hour spent on cows producing different amounts of milk on 40 farms in Northeast Mississippi, 1944.

When winter production was relatively high, the average production per cow for January was 392 pounds, or 13 pounds per day. Low winter producers gave less than ½ gallon of milk per day, which indicates that the low producers were practically dry.

The yearly per day cost of keeping the average cow on the five farms where production of milk was low in winter months was $0.29. The yearly per day market value of the milk produced on these same farms was 3.72 cents per pound. With a cow producing 4 pounds per day, the daily value of milk per cow was 14.88 cents. Thus the average cow on the five farms where winter production was low was kept at a loss of about 15 cents per day during January. The loss per day would have been greater if the daily cost had been determined for the month of January. This unfavorable situation continued through February and on into the spring months until production increased sufficiently to equal cost of production. In the fall months, production dropped to the point where daily costs per cow for the months of October, November, and December were greater than the daily value of milk produced.

On the other hand, the yearly per day cost to keep the average cow on the five farms where production of milk was relatively high per cow in the winter months was 39.7 cents. The yearly per day market value of the milk produced on those same farms was 3.85 cents per pound, and with a cow producing 13 pounds of milk per day in January, the daily value of milk produced was 50.1 cents. Therefore, the average cow on the five farms where winter milk production was relatively high was kept at a gain of 10.4 cents per day. This gain was above all costs including labor.

Summary

This study was based on farm records kept by 40 farmers in 5 counties of Northeast Mississippi for the year 1944. Farms were selected in the Black Prairie, Northeast Highland, and Pontotoc Ridge soil areas, and were further selected on the basis of emphasis placed on milk cows and cotton.

The average acreage per farm was 170 with cropland amounting to 44 percent. Open, tillable pasture amounted to 25 percent of all land, and open nontillable land represented 12 percent.

Milk cows were the most numerous livestock on the average farm with 14 head each. The range in number was from 4 to 40.

The average investment per farm was $10,743. Total real estate investment amounted to $38 per acre and livestock, equipment, feeds, and miscellaneous supplies amounted to $25.20, which gave a total farm investment of $63.20 per acre. Average farm receipts amounted to $5,930; farm expenses were $3,973, and the average labor income was $1,420 per farm.

Milk was produced for sale on all farms. There was an average of 14 milk cows per farm with an annual production each of 3,931 pounds. The feed cost was 59.6 percent of the total cost of producing 100 pounds of milk. Man labor amounted to 27.3 percent. The net farm cost to keep a cow for one year was $120.98, and the net farm cost to produce 100 pounds of milk was $3.08. With an average hauling charge of 25 cents per 100 pounds, the cost of 100 pounds delivered at the plant was $3.33.

The cost of producing milk delivered at the plant on dairy-cotton, cotton-dairy, and dairy & cotton farms was $3.27, $4.09, and $2.83, respectively. Similarly the profit per cow was $36, —$7, and $42. The average cost to keep a cow for 1 year on dairy-cotton farms was $120; on cotton-dairy farms, $130; and $113 on dairy & cotton farms. (Price received at plant.) It will be noticed that costs were least and labor returns were highest on dairy & cotton farms.

Thirty-two farms produced cotton averaging 21.8 acres and 20.2 bales ginned per farm. The average price received per pound of lint cotton was 21.21 cents, and the cost to produce one pound of lint was 13.28 cents. Man labor constituted 60.5 percent of the total cost to produce 1 pound of lint. An average of 141 hours of man labor was required on the 32 farms to grow 1 acre of cotton. On dairy-cotton farms, 112 hours of man labor were required to produce 1 acre of cotton. On cotton-dairy farms, 151 hours were required, and dairy & cotton farms required 120 hours. The cost to produce a pound of lint cotton on dairy-cotton, cotton-dairy, and dairy & cotton farms was 13.31 cents, 13.55 cents, and 12.42 cents, respectively.

The cost to produce a bushel of corn was 95.5 cents; 100 pounds of live pork, $12.41; and the cost to keep one head of workstock for a year was $105.82.

Cotton-dairy farms had more total acres, cotton acres, crop acres, and a larger investment than the dairy-cotton or dairy & cotton farms. Farms in the Black Prairie soil area ranked highest in all measures of size of farm business. The Northeast Highland came second and the Pontotoc Ridge Area was third.

As the man work units per farm increased, the number of cows increased, acres of cotton increased, and labor income increased. Labor returns per hour of labor increased as the number of cows in the herd increased. In general, as the acres in cotton per farm increased, the man hours of labor required to produce one bale increased. This seems to be due to the fact that as the size of the farm increased, the number of sharecroppers per farm increased, which indicates that sharecropper labor was used less efficiently. Also, as the man equivalent available for work on the farms increased, the units worked per man decreased. With man labor constituting 60.5 percent of the cost of producing a pound of lint cotton, the efficient use of labor is of vital importance. Labor requirements per cow were lowest on dairy & cotton farms.

Cotton-dairy farms kept the lowest producing cows and dairy & cotton farms kept the highest producers. There was little relationship between the amount of milk produced per cow and the size of the herd. Cows producing less than 3,000 pounds of milk per year showed a loss of $15.75 per head, whereas cows producing above 5,000 pounds netted the farmers $44 each. The average annual production per cow for the 40 farms was 3,931 pounds, and production per cow on dairy & cotton farms was 4,392; on dairy-cotton farms, 3,993 pounds; and on cotton-dairy farms, 3,413 pounds. Farmers keeping cows that produced above 5,000 pounds produced the last 3,000 pounds of milk at a cost of $1.70 per hundred when compared with production per cow of less than 3,000 pounds. Labor returns per hour spent on milk cows increased as the milk produced per cow increased, and the annual labor return per cow was $85 where production averaged above 5,000 pounds.

The production of lint cotton per acre ranged from 196 pounds to 837 pounds. Seventy-five percent of the farms producing cotton had an average yield of about 400 pounds per acre, and 44 percent had a production above 500 pounds per acre. All types of farming showed an increase in man hours required per acre, total costs per acre, and profit per acre as the pounds of cotton produced per acre increased. The yield was slightly more than a bale per acre on both cotton-dairy and dairy & cotton, and only 2/3 bale per acre on dairy-cotton farms.

The principal combination of farm enterprises on farms was cotton, milk cows, corn and hay. Cotton and milk cows were the major income enterprises. Farms placing major emphasis on cotton lost $7 per milk cow, but made a profit of $38 per acre on cotton. Farms placing about the same emphasis on both cotton and milk cows received the greatest return per cow and per acre of cotton. Farms producing milk at the highest cost produced twice the acreage of cotton that was produced on low cost farms. Variations in the proportionate combinations of enterprises on farms producing cotton and milk at a high cost and a low cost (table 23) was not significant, except for the difference in cotton acreage, which would indicate that differences in costs were due more to such factors as capacity of cows, feeding practices, pasture per cow, quality of seed, amount of fertilizer used, soil fertility, labor efficiency and the managerial ability of the farmer.

The cost to produce one pound of cotton increased as soil fertility decreased. The cost relationship was the same for each of the soil areas.

The rate of crop production was highest where soil-crop adaptation was good. The cost of producing cotton per pound was 23 percent greater on farms with poor soil-crop adaptation than on farms where soil-crop adaptation was good. It cost 50 percent more to produce corn on farms where the soil-crop adaptation was poor than where it was good; and labor income was highest on farms where soil-crop adaptation was good, and lowest on farms with poor soil-crop adaptation.

Sixty-four percent of the milk produced by 571 cows on 40 farms was produced from April to September, inclusive, or in one-half of the year. The daily average amount of milk sold per cow in the months of January, February, and March was 7.3 pounds, or less than 1 gallon. Milk production per month for the 571 cows increased 117 percent from January to May, and decreased 50 percent from July to November. Cows producing below 3,000 pounds of market milk per year, and dropping very low in winter production, produced milk at a cost of $3.88 per 100 pounds with a labor return of 25 cents per hour. Cows producing from 4,000 to 5,000 pounds of market milk annually produced at a cost of $3.41 per 100 pounds and gave a labor return of $0.58 per hour.

On five farms where milk production was lowest per cow in January, the average amount produced daily by each cow was 4 pounds—less than 1/2 gallon. These same cows reached their peak production of 14 pounds of milk per day or 1.6 gallons in May. On five farms where winter production was relatively high, the average daily production per cow in January was 13 pounds. Low winter producers were kept at a loss of 15 cents per day in January, and relatively high winter producing cows were kept at a gain of 10.4 cents per day. Profit per cow was three times as great and labor returns per hour were twice as great, on farms where winter production per cow was relatively high.

The cost to produce one acre of cotton was greater where share-croppers were used, but this was due principally to the high cost of labor which was paid with one-half of the cotton crop and to less efficient use of this labor available on the larger farms.

In summary, the findings of this study appear to suggest the following recommendations:

Keep high producing cows. Cows with a production below 3,000 pounds gave an annual labor return of $14. On farms where production was above 5,000 pounds, the return was $85 per cow.

Grow cotton on soils of high fertility. The cost to produce cotton on farms of high soil fertility was 12.58 cents per pound, whereas the cost was 14.67 cents on farms of low soil fertility, or a cost spread of nearly 2 cents. This spread of cost between high and low fertility farms was nearly 4 cents per pound in the Black Prairie area. On land that produced between 700 and 800 pounds of lint per acre, the profit on each acre was $83. On land that produced between 200 and 300 pounds of lint, the profit per acre was only $15.

Use labor more efficiently. Cows on which 125 hours were spent gave a labor return of $0.56 per hour, and cows on which more than 200 hours were spent gave a labor return of only $0.18 per hour.

The average cost to grow a pound of lint was 13.28 cents. Labor amounted to 8.04 cents of this cost, or 60.5 percent of the total cost to produce a pound of lint cotton. On farms where the average labor performed per man available was less than 100 days during the year, the man labor cost to produce 1 pound of lint cotton was 9.3 cents. Where the days of labor per man were 250 and above, the man labor cost was 5.2 cents per pound.

Place major emphasis on both cotton and dairy enterprises. There is a definite place for both cotton and milk cows in the organization of farms in Northeast Mississippi. This combination of enterprises permits more efficient use of labor and farm by-products, and cotton and dairy cows supplement each other by giving the farmer a higher return per hour for his labor.

Labor return per hour spent on milk cows on dairy & cotton farms was $0.61. On dairy-cotton farms the returns were $0.47 per hour and on cotton-dairy farms it was only $0.22 per hour. On dairy & cotton farms labor returns per hour spent on cotton was $0.81, whereas it was $0.49 and $0.61, respectively, on dairy-cotton and cotton-dairy farms.

Grow crops on soils to which they are best adapted. On farms where soil-crop adaptation was good, the cost to produce a pound of cotton was 12.42 cents, and the cost to produce a bushel of corn was $0.94. Where soil-crop adaptation was poor, the cost was 15.17 cents per pound for cotton and $1.41 per bushel of corn.

Feed cows for winter production. Low winter producers gave a labor return of $0.35 per hour. Relatively high winter producers returned $0.72 per hour.

Breed for winter production. Cows bred to calve in the late fall are available for their best flow of milk in the winter months as well as in the spring and early summer months.

Reduce costs by increasing rates of production. Farms that produced cotton at the lowest cost had the highest yields, or 1.14 five-hundred pound bales per acre, and farms producing cotton at the highest cost had the lowest yields or 0.78 five-hundred pound bale per acre.

Cows producing less than 3,000 pounds of milk annually, produced it at a cost of $4.51 per 100 pounds, and cows producing more than 5,000 pounds produced it at a cost of $3.11 per 100 pounds,, or a difference of $1.40.

Large farms should use available labor more fully. Days of work (10-hour days) per man on farms with more than three man equivalents available averaged less than 125 for the year. Days of work per man on farms with 1.6 man equivalents available averaged 310.

Keep only workstock needed. The net cost to keep one head of workstock for a year was $106.

Use workstock more efficiently. The average head of workstock was used only 46 ten-hour days during the year.

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MISSISSIPPI DELTA PEACH CULTURE

By
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Mississippi Delta Peach Culture

By L. R. FARISH[1]

In past years tree fruit production in general, and peach production in particular, was believed to be more confined mainly to areas of higher elevations. Most men who were considered authorities on peaches warned against planting the trees in valleys of low elevations.

This is because the cold air on frosty nights settles from higher to lower elevations and often causes more frost injury to the fruit buds, blossoms or young fruit on trees at the bottom than at the top of the hill. If the valley is narrow with hills nearby on either side, the cold air will settle into the valley from both directions and often causes much frost injury, and some years the whole fruit crop is lost. This trouble is also apt to occur at the bottom of the "foot hills" on the east side of the Delta where the cold air settles down to level land from the adjacent hills.

However, it does not seem to occur in the open Delta area several miles from the "foot hills". The indications are, from observations made at various times, that no more frost injury to peaches occurs in the middle of the Mississippi Delta than in the hills section of this state of the same latitude. In other words, trees grown in a large valley several miles from a hill do not seem to be affected by the settling of cold air from higher to lower elevations.

Some very good fruit has been produced in recent years in some of the small peach orchards of the Mississippi Delta plantings and some of the well-drained Delta soils seem to be well adapted to peach production.

Propagation of Peach Trees

Peach trees are usually budded on peach seedlings grown from Tennessee native peach seeds. The seeds are stratified for approximately 3 months before planting out in the nursery rows in early spring.

Seeds are stratified by placing in some moist medium such as sand. Place a layer of sand in a box, then a layer of seed. Repeat this until the box is full or all seeds are used, covering the top layer of seed with about two inches of sand. Place in a cool location and keep moist at all times, but do not allow water to stand in it. The box should have enough holes or cracks in the bottom to allow good drainage.

The best temperature for stratification is from 35 to 40 degrees Fahrenheit. If a cold storage room is available at this temperature the box can be left in it for about three months, but if not, place in a cool shady place and leave exposed to the winter temperatures.

The seedlings may be budded in late June if the trees grow off vigorously; then the tops are cut off to force out the inset buds approximately 15 days after budding. If this practice is followed, they may be transplanted to the orchard the following winter as "June-budded" trees.

Another practice of producing the nursery stock is to bud them in August or early September and wait until the following spring to cut off the tops to force out the inset buds. The trees are grown in the nursery the remainder of that growing season and then transplanted to the orchard the second winter as 1-year-old trees. The top will be 1 year old and the roots 2 years old. The T-bud is the type of budding most commonly used with peaches.

Location of the Orchard

Convenience to home. The home orchard will have better care and the fruit will have more protection from "visitors" if it is set near the dwelling of the operator or caretaker. The house is usually located on a rise that affords good drainage which is essential if peach trees are to grow properly.

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Soil adaption. Peach trees are adapted to a rather wide range of soil type. The subsoil must have good drainage as well as the top soil because peach roots extend several feet into the ground in well-drained porous soil. It is essential for the trees to have a good root system in order to have a great absorption capacity during dry periods of the summer months. Trees grown in a heavy, poorly-drained soil do not form an extensive root system, and as a result, the trees suffer badly from the lack of root absorption capacity during summer droughts.

Delta sandy loam and silt loam soils with well-drained subsoils are considered good peach soils, while most buckshot soils are not good peach soils because of their poor internal drainage.

Avoid setting new orchards behind old one. Some farmers have a certain area set aside for a home orchard and when one peach tree is removed, another is set in the same spot. This is a bad practice because roots of the old trees often carry disease organisms that will attack the roots of the new trees. If nematodes are present on roots of the old trees, they are almost certain to attack roots of the young peach trees if set in the same place.

Another objection to setting new peach trees where old ones have been removed is the fact that roots of old peach trees become toxic to the roots of new trees planted in the same place where the old ones were grown. This toxic effect on the roots retards the growth of the young trees.

A good example of this was observed in a young peach variety planting at the Delta Branch Experiment Station, Stoneville, Mississippi. The test with an old orchard was completed and the trees pulled in the late summer of 1942. Young peach trees for a variety test were set the following winter (1942-43) in the same locations where the old ones had been removed. Then 1 year later another variety planting was made in the same orchard. This planting was in the same rows but half way between the trees set in the winter of 1942-43. It was observed that the trees set in the winter of 1942-43 in the locations where the old peach trees had been removed did not grow at all satisfactorily. They were fertilized well with nitrate of soda but still the growth was depressed. The trees set a year later half way between the sites from which the old ones had been removed grew normally. At the end of the growing season of 1944 the trees that had grown in the orchard for only one year were larger than those that had grown there 2 years, and in the late summer of 1945 the 2-year-old trees were larger than the 3-year-old ones.

Measurements and photographs (figure 1) were taken of both lots of trees in the winter of 1946-47 after the younger group had grown in the orchard 3 years and the older ones 4 years. The measurements (table 1) show that the average trunk diameter and top area of the younger trees were much greater than that of the older ones.

Both groups of trees were grown in the same rows and had the same cultural treatments except that the older trees were given a higher nitrate application than the younger ones in order to overcome some of the dwarfing effects. The toxic effect of the old peach roots on the 4-year-old trees is believed to be responsible for the dwarfing of these trees.

Choice of Varieties

Peach variety studies have been conducted at the Delta Branch Experiment Station for a number of years. Yield records have been kept of individual

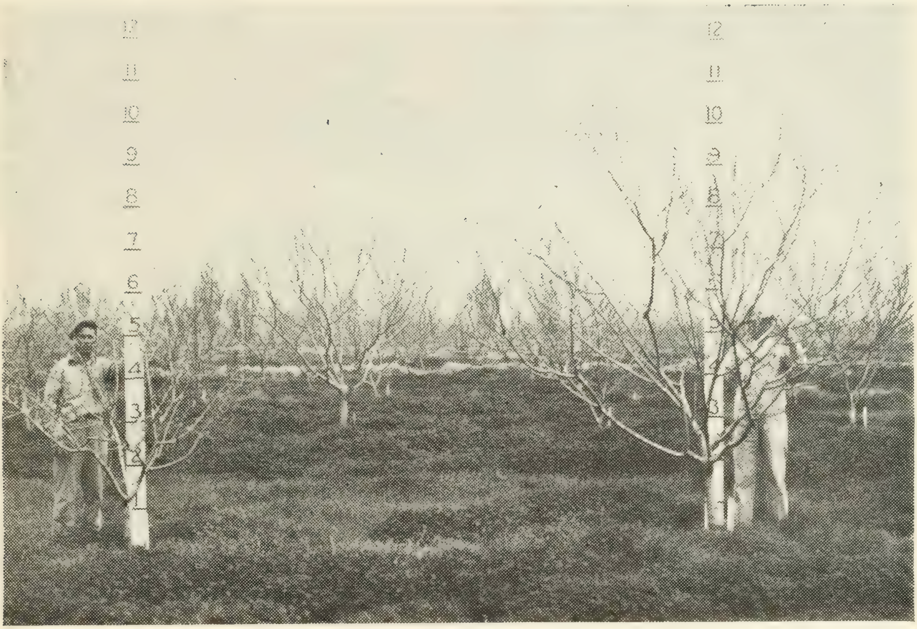

Figure 1. Row of 4-year-old trees on left which were grown in sites where old peach trees had been removed just before setting these trees. A row of 3-year-old trees on the right were grown half way between the sites where the old peach trees had been removed. Note that the 4-year-old trees were dwarfed by the toxic effect of the roots of the old peach trees on the roots of these trees, while the growth of the 3-year-old trees was normal.

Table 1. Measurements of peach trees grown on an old orchard site.

Treatment	1946 shoot growth in inches	Diameter in inches	Height in feet	Spread in feet	Percent living in fall 1946
4-year old trees*	9.4	2.2	7.0	7.5	85
3-year old trees*	27.0	3.1	10.0	10.2	85

*The 4-year-old trees were set in the spots where the old trees had been removed and the 3-year-old trees were set one year later and half way between the spots where the old trees had been removed. Roots of the old trees were toxic to the 4-year-old trees. Dwarfing of this group of trees was the result.

trees and fruit buds examined after hard freezes to determine their ability to with stand low temperatures. Eating quality of the fresh, frozen and canned products from some of the varieties have been studied. Tree vigor and hardiness have also been observed for a number of the varieties.

Time of ripening is very important in peach varieties and this has been recorded. Late varieties are more apt to become infested with Oriental fruit moth larvae and brown rot than the early or mid-season varieties. The early or mid-season varieties are also in more demand than late ones in certain localities. The ability to withstand handling is very important. Some varieties, such as Golden Jubilee and Oriole, have good eating quality but

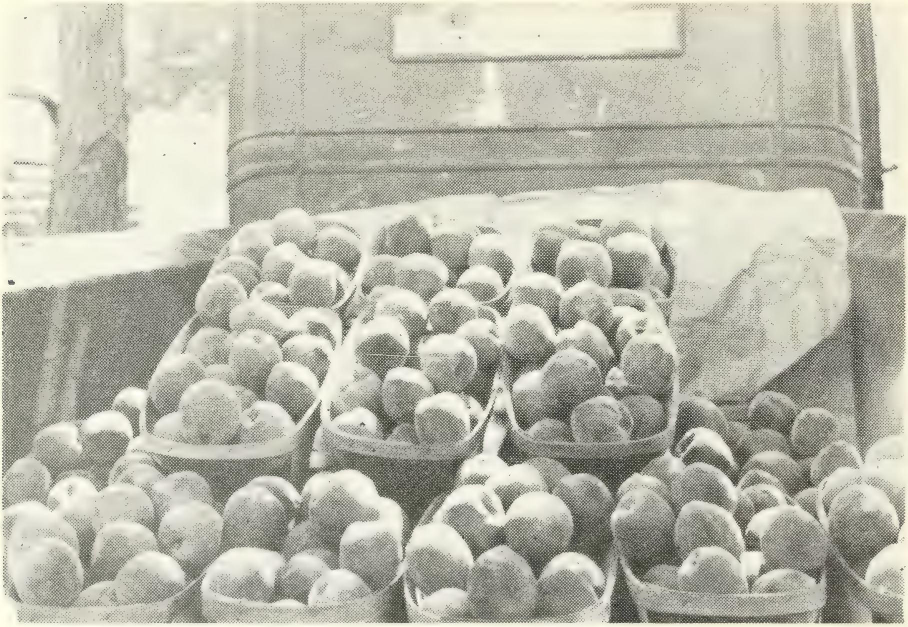

Figure 2. Ripe fruit of the Redhaven variety.

are not desirable commercial varieties because of their poor handling qualities.

Some of the popular older varieties and more promising new ones that have been tested here are described briefly below in groups according to ripening periods.

Very Early Varieties

Dixiered. This is a new variety developed by the Bureau of Plant Industry at Fort Valley, Georgia. It is very early, ripening about a week later than Mayflower. It has good eating quality for a peach ripening at that season, and the flesh is yellow which is usually preferred over the white flesh.

Early Varieties

Redhaven. This is a very attractive early peach, ripening about 3 weeks later than Mayflower. It is said to be a little small in some localities but has "sized up" well in the Delta Branch Experiment Station. It is a fairly good canning and freezing peach and is considered good for peach pickles. However, the fruit buds and trees do not seem to be very hardy.

Oriole. The flavor is extra good in this variety, but it is too small and too soft for commercial handling. It is recommended only for home use.

Cumberland. None of the peaches excel this one in setting fruit buds, and they are very hardy. However, the quality is just fair and very soft for handling or for canning. It is suggested only for home use.

Golden Jubilee. This is a large yellow peach which has borne well at the Delta Branch Experiment Station for the past 2 years. The fruits are large and attractive but are too soft for commercial handling or for canning. It has good fresh eating quality and also good freezing quality.

Medium Early Varieties

Sunhigh. This is a new variety which is becoming very popular as a commercial peach in the East. It has good eating and canning qualities and is a very attractive peach with a yellow firm flesh of fine texture. It should become a popular peach in this locality.

Halehaven. This variety has become very popular in many areas in recent years. It is an attractive peach with good eating, canning, and freezing qualities. Some objections have been raised on its size in some localities, but it has "sized up" well in the Delta.

Vedette. This is a good peach, but it ripens the same time as the Halehaven and has not proved to be any better than the latter at the Delta Experiment Station.

Hiley. The eating quality of this peach is good. It is a white peach and is similar to the Belle of Georgia except that it is about 10 days earlier than the latter.

Triogem. This variety is rather new in this locality but has looked very good at the Delta Branch Experiment Station the past 3 years. The flesh is rather firm and is a good canning peach.

Ambergem. This is a clingstone yellow peach with very high quality after it has been processed for canning. The flesh is very firm and handles well, but it is a little tough for eating fresh; however, it becomes a very fine texture and has a pleasing taste when canned. It is excellent for peach pickles but must be processed longer than most varieties.

Main Crop Varieties

Belle of Georgia. This is the most popular white peach in this area. The fresh eating quality is of the best among peaches, but it is a little soft for commercial handling. It is considered good for canning so far as white peaches are concerned, but white peaches are not as popular for canning as yellow ones.

Early Elberta. This is a very beautiful large yellow peach of high quality for eating fresh, canning or freezing. It is about a week earlier than Elberta, is not as firm as the Elberta, and has more peach fuzz than does most varieties.

Elberta. For many years this has been the "Peach King" in commercial plantings, and it is still the most popular variety on the market. It is large, fairly firm, and good for canning or for freezing. It produces well.

Setting the Orchard

Type of trees and their care from nursery to orchard. A grower may purchase from most southern nurseries either "June-budded" or "year-old" trees. The "June-budded" trees are usually cheaper and if they are vigorous plants are often more desirable in many respects than the "year-old" trees. The older trees have often been stunted by being over-crowded in the nursery row; and the branches are usually in the wrong place or poorly shaped. Desirable branches are more apt to form at the proper locations on young trees than on older ones. The "June-budded" trees have a greater root system in proportion to the top, and they usually grow faster and often are larger at the end of the second year than older trees.

When the trees are taken from the nursery, they should be dug with a good root system and the trees picked up immediately and handled carefully in order not to injure either the tops or roots. The roots should be kept covered and not allowed to become dry.

If the trees are purchased from a nursery, they should be unpacked and "heeled in" immediately after receiving them, being sure that all the roots are covered with moist soil. Trees are "heeled in" by digging a trench, placing the young trees in this trench with the tops extending upward in a slanting position, and then covering the roots with moist

Table 2. Characteristics of peach varieties grown in the Yazoo-Mississippi Delta.

Variety	Time of ripening*	Relative yield	Fruit size	Flesh color	Flesh firmness	Stone adherence	Fruit eating quality		
							Fresh	Canned	Frozen
Dixiered	June 5-15	medium	medium	yellow	medium soft	cling	fair		
Redhaven	June 20-30	medium	medium	yellow	medium	semi-cling	good	good	good
Oriole	June 20-28	medium	small	yellow	soft	free	very good	good	good
Cumberland	July 1-10	very good	medium to large	white	soft	free	fair	poor	
Golden Jubilee	July 1-10	good	medium to large	yellow	soft	free	good	fair	good
Sunhigh	July 12-22	good	medium	yellow	firm	semi-cling	good	good	good
Halehaven	July 10-20	good	medium to large	yellow	medium	free	good	good	good
Vedette	July 12-20	good	medium	yellow	medium soft	free	good	fair	good
Triogem	July 8-20	good	medium	yellow	medium firm	semi-cling	good	good	good
Ambergem	July 12-25	good	medium to large	yellow	very firm	cling	fair	very good	very good
Hiley	July 10-20	good	medium	white	medium soft	free	good	fair	good
Belle of Georgia	July 17-27	very good	medium to large	white	medium soft	free	very good	fair	very good
Early Elberta	July 20-30	very good	large	yellow	medium firm	free	very good	good	very good
Elbert	July 25-Aug. 5	very good	large	yellow	firm	free	good	good	good

*The date of ripening for each variety will vary from year to year, sometimes several days.

soil. It is better that the trees be "heeled in" near the new orchard and only a few trees taken up at a particular time, being certain that they are transplanted immediately to avoid drying of the roots.

Time, distance and method of setting trees. Peach trees may be set in this locality any time during the dormant period, mid-winter being a good time for transplanting them.

The rate of tree growth, which is determined by the orchard care and soil fertility, determines the planting distance that should be used in setting a peach orchard. If good care is given the trees grown in fertile, well-drained soil, they will grow large and should be set in rows from 25 to 30 feet apart and the trees 20 feet or more apart in the row.

Some growers set the trees on a square (25 x 25 ft.) However, if the rows are wider apart than the trees in the row, it makes the spraying and care of the orchard more convenient than if set on a square. Rows 30 feet apart with the trees 20 feet apart in the row allow ample room between rows for orchard operations. This distance is satisfactory for peach trees on most Delta soil; however, it might be best to space the trees in the row 22 or 24 feet apart in some of the most fertile Delta soils. If the branches begin to interlock in the row, they can be cut back some on the two sides of the tree which will prevent crowding.

The holes for setting the trees should be large enough to prevent crowding of roots in the hole, and the roots should be spread out in all directions if possible. The tree should be set 2 or 3 inches deeper than it grew in the nursery. It is better to place about three shovels full of loose soil and tamp it well before filling the hole.

Cultural Practices

Sod Culture. Sod culture, using both grasses and legumes separately, and the two combined, have been used very successfully in apple and pear orchards. This practice seems to be successful in this locality as it is elsewhere with these two crops. Sod culture has also been fairly satisfactory with peaches in some localities under certain conditions; however, the degree of success with peaches has been more confined to special conditions than is true with its use in apple and pear production.

When sod culture is used in peach orchards, the herbage should be clipped with a mower rather frequently during the spring and early summer. Sometimes a straw or legume mulch is used around each tree in combination with the sod culture. This system seems to be more satisfactory with peaches in most areas than sod culture without the mulching.

Clean culture. Many of the commercial peach growers in other states practice clean cultivation without any herbage growing in their orchards at any season of the year. This may not be the best system, but when it is practiced, it is usually necessary to apply nitrogen fertilizers in some form each year in order to keep the trees growing vigorously. If ample fertilizers are applied, this system seems to be satisfactory in some areas. In fertile soils, it is not always necessary to add a great deal of fertilizer each year.

Clean culture in summer plus legume cover crops in winter. Many of the more successful peach growers supply a part, or all, of the nitrogen for their trees by growing a winter legume cover crop in the orchard and disking it in each spring. Vetch, winter peas, and bur clover are some of the crops often used in peach orchards. This system seems to be very satisfactory in the Mississippi Delta, and bur clover seems to be well adapted to Delta soils for this purpose.

Cultural Studies Conducted at Delta Experiment Station

In 1943 a preliminary cultural test was

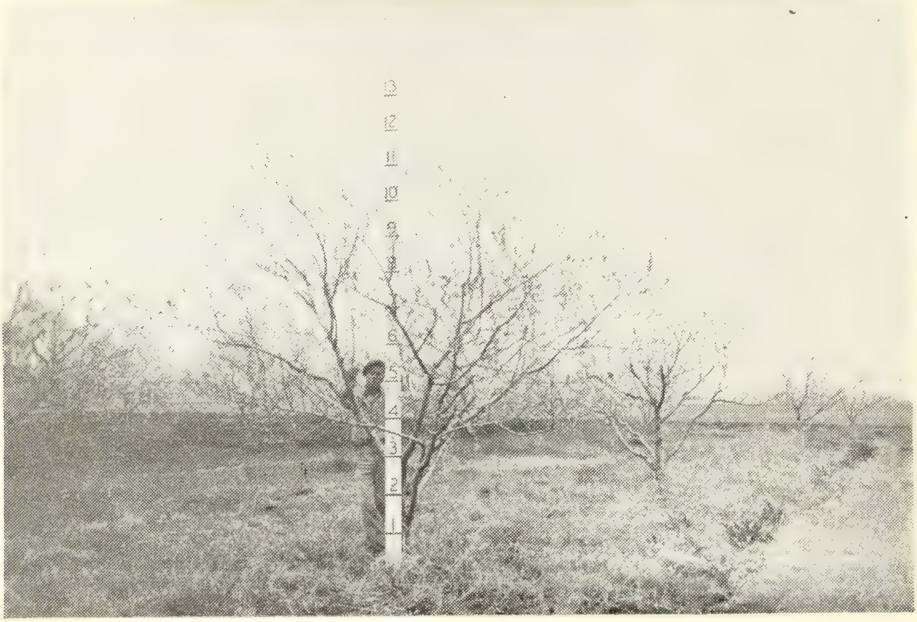

Figure 3. A row of 5-year-old trees grown in sod plus annual applications of nitrogen fertilizer.

initiated at the Delta Experiment Station to determine whether or not it would be practical to grow peaches in this locality under sod culture. The following treatments were used: (1) sod, (2) clean culture, and (3) clean culture in summer plus bur clover as a winter cover crop. This was set up in a young orchard which was set for a variety planting. The cultural treatments ran across the varieties which were set in straight rows with one variety in each row. Each cultural treatment was two trees wide and five trees long, and each treatment had two trees of each of the five varieties. Trunk measurements as well as height and spread of tree measurements were taken in the winter of 1946-47, which was the end of the fifth growing season in the orchard. Photographs were also taken in the spring of 1947 or representative trees in the sod culture and in the cultivated block (figures 3, 4 and 5).

All three of the tree measurements (table 3) were greater in the cultivated treatments than in the sod treatments. and the average yield per tree of marketable fruit over 2¼ inches in diameter was much greater in the cultivated blocks. The percent of living trees in 1946 was also greater in the cultivated plots. Each of the three tree measurements was greater in the bur clover treatments than in the cultivated ones without a cover crop, but there was no difference in the average yield of marketable fruit per tree in these treatments for the years 1945 and 1946.

Table 4 gives the three tree measurements and percent living plants of 2-year-old trees grown in four different cultural treatments. This table shows that nitrogen increased the growth of trees grown in sod and also in clean culture. Cultivated trees were much larger than the ones in sod, and cultivated trees with no fertilizer were larger than those in sod with nitrogen applied.

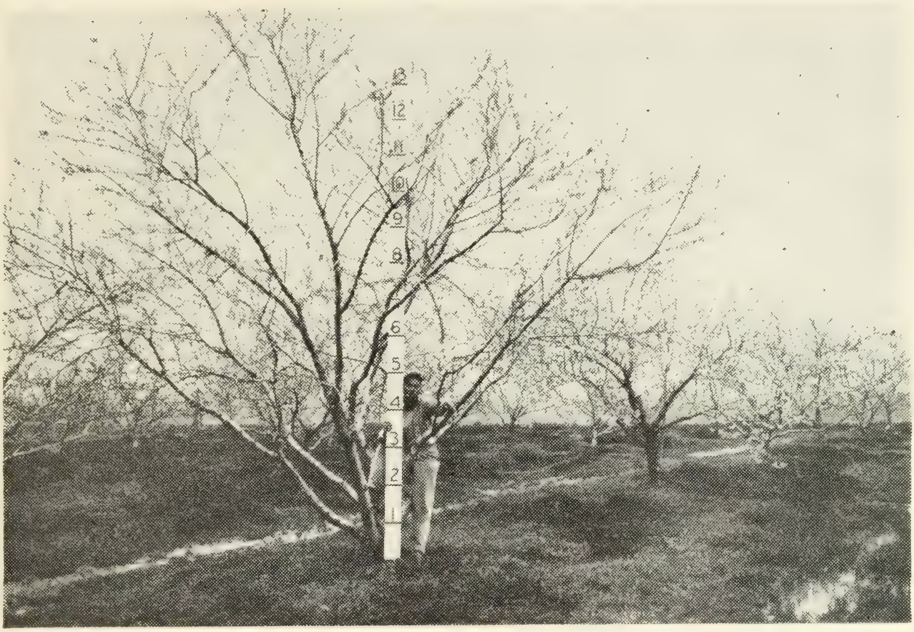

Figure 4. A row of 5-year-old trees grown in clean culture plus the same amounts of nitrogen fertilizer applied per tree annually as in figure 2.

Table 3. Measurements and yield of trees in peach cultural test; 5-year-old trees.

Treatment	1946 shoot growth in inches	Diameter in inches	Height in feet	Spread in feet	Percent living in fall, 1946	Average yield 1945-46*
Sod	9.3	5.5	10.6	14.5	90	1.55 bu.
Clean cultivation	25.5	6.2	12.9	19.6	100	5.44 bu.
Cultivation plus bur clover	23.0	6.8	14.4	22.6	100	5.88 bu.

*Yields are recorded in bushels per tree of marketable fruit more than 2¼ inches in diameter.

Table 4. Measurements of trees in peach cultural test; 2-year-old trees.

Treatment	1946 shoot growth in inches	Diameter in inches	Height in feet	Spread in feet	Percent living in fall 1946
Sod	18.0	1.2	4.8	2.9	79
Sod plus nitrogen	30.0	1.3	5.6	4.3	53
Cultivation plus nitrogn	44.2	1.8	6.9	5.8	100
Cultivation	38.7	1.4	6.0	5.1	100

Growing crops between peach rows. No production is expected for the first 2 years, and sometimes very little is obtained the third year after setting the peach trees. Another cash crop, such as cotton or soybeans, may well be grown between the peach rows for the first 2 years and even during the third year if a crop of fruit does not set. No summer cash crop should be planted between the peach rows after they come into full production. Tall growing crops, such as corn and sunflowers, should not be planted in the peach orchard at any

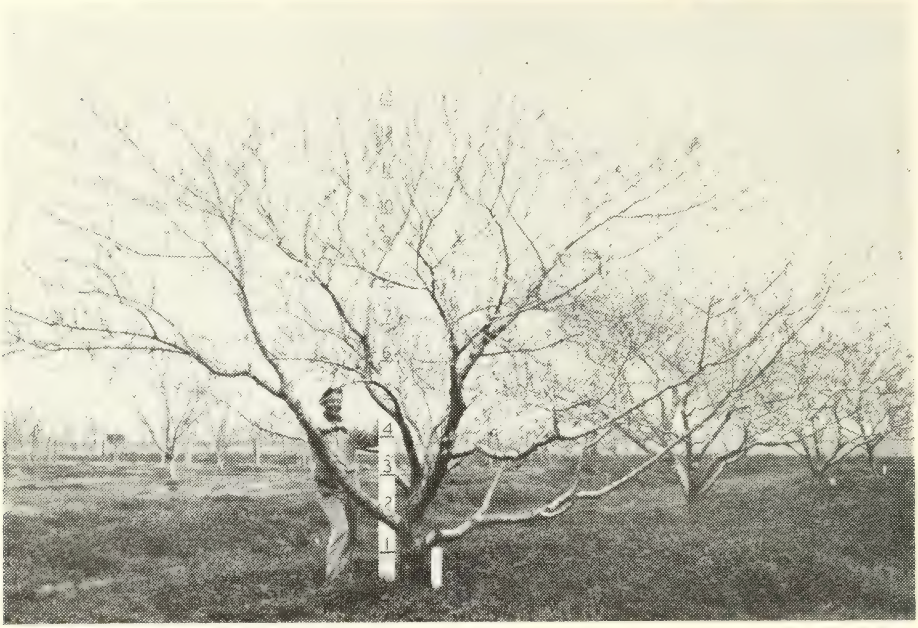

Figure 5. A row of 5-year-old trees grown in clean culture in summer plus bur clover cover crop in winter, but no nitrogen fertilizers added after the trees were 2 years old.

time. When other crops are grown in the young peach orchard, they should not be planted too close to the young trees. Ample space should be left between the trees and other crops to allow cultivation of the trees without injuring them.

Fertilization

Although peaches require a complete fertilizer for maximum production in some of the sand hills of the South Atlantic Coastal States, they seem to respond only to applications of nitrogen on the fertile soils of the Mississippi Delta. Nutritional studies at the Delta Experiment Station indicate that peaches do not respond to applications of either phosphorus or potash on the Deer Creek loam soil. Observations made at the Delta Station indicate that bur clover, used as a winter cover crop, supplies an ample amount of nitrogen to bearing peach trees and that no extra nitrogen is needed where a good crop of bur clover is grown each year.

According to observations made, the indications are that an economiccal method of peach culture in this locality would be to grow either cotton or soybeans as a cash crop between the peach rows for the first 2 years after setting the orchard. Apply approximately ½ pound of nitrate of soda per tree per year for these 2 years; then seed the orchard to bur clover in the late summer of the second year, let the bur clover mature seeds the first spring before disking, and let it mature seed every 2 or 3 years thereafter.

Bearing peach trees in this locality which do not have a winter legume growing around them should be fertilized with some kind of nitrogen fertilizer. The early spring is a good time to make this nitrigen application, and it should be scattered under the spread of the trees' branches and disked into the soil.

Trees from 3 to 5 years old should have from 1 to 2 pounds of nitrate of soda or its equivalent per tree each year. Trees 6 years old or more of age should have from 2 to 4 pounds of nitrate of soda or its equivalent per tree each year.

Older trees with poor vigor need more nitrogen to stimulate new growth than do thrifty trees. Trees in poor soil will also need more nitrogen to keep the trees growing vigorously than do those in fertile soil. As a general rule, peach trees growing in good Delta soils do not require as much nitrogen as trees in the sand hills.

Pruning

Training the young trees. The most critical stage in developing a well formed peach tree is during the first two growing seasons in the orchard. The pruning given during these first years is known as "training" and this is very important to form a tree with the proper shape and strong crotches between the main trunk and scaffold limbs. This training should begin at the time of setting in the orchard, if the young trees contain any branches.

The undesirable branches, those with sharp crotches and those out of place, should be removed. Some of the ones left may need cutting back; however, "June-budded" trees with no branches will not usually need any pruning before the young branches start out in the spring. Then the desirable ones in the proper locations should be selected and the others removed. They may be pinched off if removed when very young and tender.

The young trees should be gone over two or three times during the first spring and summer to remove undesirable branches or those in the wrong locations; then they should be gone over once or twice the second spring and once the second winter to remove branches that are out of place. The trees will be fruiting the third year if they grow properly.

Pruning the bearing trees. There is very little summer pruning to be done after the peach trees come into bearing, which is usually the third growing season in the orchard. Water suckers growing out of place may be removed during the summer, but one good pruning during the dormant season is usually sufficient for most bearing trees. Pruning for the first 3 bearing years of the peach trees should be mostly a "thinning out" of the small and weak branches and also those crowding in the tree. If some of the branches are growing too tall, they may be cut back some to keep them within reasonable bounds. However, it does not seem practical to head back peach trees in the Mississippi Delta, as low as is the common practice in some of the commercial peach areas of Georgia and South Carolina. They grow too rapidly and too large on good well-drained soil in this locality to attempt to make dwarf trees of them. The large trees give higher production under favorable growing conditions.

Heading back older trees. After peach trees have been bearing for several years in fertile soil of this locality, some of them have a tendency to form long slender branches with most of the fruiting surface on the ends of these branches.

Under such conditions, the fruit is too far from the trunk and the branches have a tendency to break or split and the production of large fruits might be reduced. In other instances, the branches might become injured with scale or by machinery. Under either of these conditions, it is usually advisable to cut back the main branches from 3 to 5 feet from the trunk and form a new head of bearing wood. A crop of fruit will be lost the first year after cutting back, but a fair crop will be expected the second

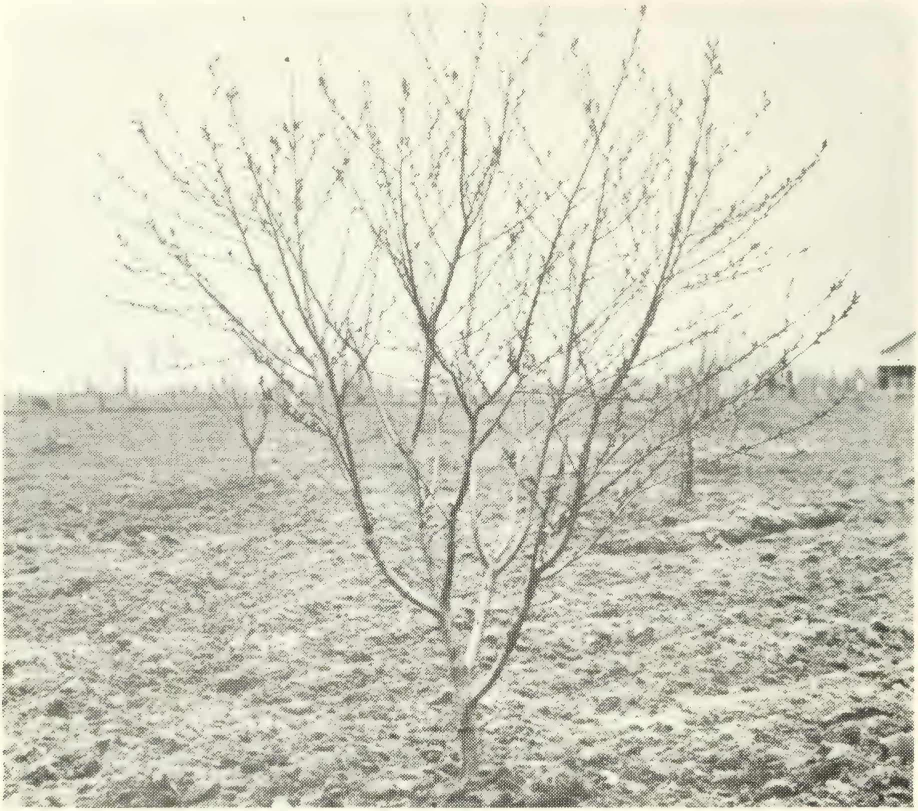

Figure 6. A 2-year-old peach tree before pruning.

year and a full crop the third year.

This kind of treatment often puts some trees back into production that might otherwise become unprofitable to keep in the orchard. It is usually not advisable to give all the trees in the orchard this treatment at once unless the fruit buds have been killed by a hard freeze; it is then often advisable to do some rather heavy cutting back of older trees.

Fruit Thinning

Fruit thinning is a very important step in the production of large fancy peaches in this locality. Thrifty trees usually set more fruit than they can develop into a high percentage of attractive peaches. Although thinning of the fruits might not increase the total pounds or bushels of fruit, it greatly increases the percent of large fancy fruit. Since the large size fruits are much more valuable than the small ones, the total value of the crop is usually increased by thinning when the fruit set is heavy. When the fruit set is light, it might not always pay to thin.

Thinning is usually started when the young peaches are about the size of quail eggs and continued until finished. The job should be finished before fruits are the size of bantam hen eggs. When performing the thinning operations, all the deformed fruits and those damaged by insects should be removed. Only the large normal shaped ones should be left and they should not be touching each other. The crevices between touching fruits offer perfect protection for insects and disease organisms to gain an entrance. Therefore, this danger should be corrected at fruit thinning time.

No set rule can be laid down on the exact number of fruit to leave on each twig because a large vigorous branch can support two or three times as much fruit as a small weak twig of the same length. In case a vigorous shoot has only a few fruits set and they are all within a short distance on the twig, two or three fruits may be left fairly close together and still develop into large peaches, provided they are located in such a manner that they will not touch each other before maturity. On thrifty twigs the fruit should average 4 to 6 inches apart.

The young fruits should be destroyed or buried soon after being removed from the trees. This practice will destroy many curculio larvae that would otherwise develop into adult beetles which lay the eggs for the later generation of worms attacking the peaches at the ripening stage. In other words, the worm infestation of ripe fruits can be reduced by a careful thinning job, provided the young peaches are destroyed soon after being removed from the trees.

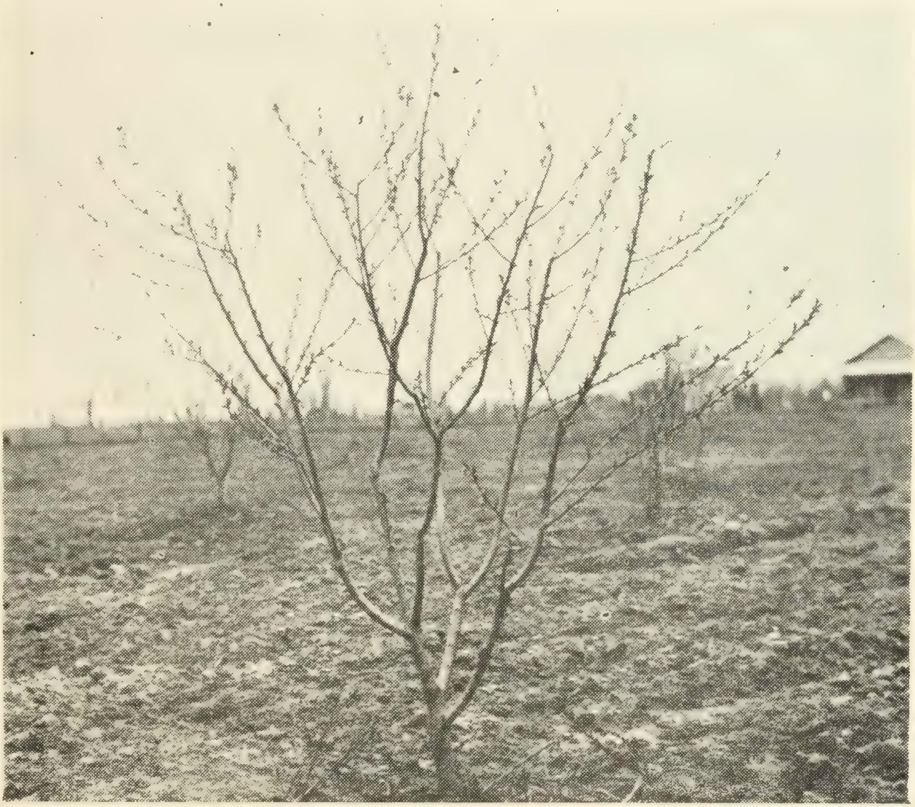

Figure 7. The same tree as in figure 6 after pruning.

Harvesting the Crop

Peaches which are to be eaten fresh or frozen immediately after harvest should be picked when fully ripe, but if the fruits are soft, they will not stand much handling. In other words, tree-ripened peaches must be handled like eggs to avoid bruising. The main peach crop which is to be handled commercially must be picked before the fruits become soft. They are usually picked by color at the stage called "firm ripe."

A careful worker can soon learn the color of some of the leading varieties which appear just before the fruits become soft. This is the correct stage of ripening to harvest the crop. The fruits can be handled at this stage much better than they can after they become soft. However, careful handling must be employed at all times from the tree to the consumer in order to prevent bruising. The fruits might be bruised rather easily even if they are still firm.

The baskets of fruit should be handled with care as well as the individual fruit, and the hauling of the crop over rough ground should also be done very carefully to avoid bruising. Baskets of fruit kept over night should be in a room or shed with a continuous air circulation. If some of the crop is held for 2 days or more, it should be in a refrigerated room at temperatures slightly above freezing.

Control of Disease and Insect Pests

The old adage of "an ounce of prevention is better than a pound of cure" is certainly true in the control of peach disease and insect pests. If the grower waits until his fruit become badly infested with brown rot or curculio before starting the control measures, he is most certain to lose the bulk of his current crop. However, if he starts early in the season and makes timely applications of the correct materials in the proper manner, and practices sanitary control in connection with spraying or dusting, he can expect a reasonable degree of success. Good spraying is usually more effective than dusting, but good dusting is considered better than a poor spraying job.

In order to do a good job of spraying, it is essential to have a good power spray machine. An auxiliary motor and tank holding 300 gallons or more of liquid is almost essential to do a good job of spraying a commercial peach orchard. A small machine might be used in a small orchard, but it is usually difficult to do a satisfactory spraying job with a small machine.

Workers at the Delta Experiment Station have tried spraying both from the ground and from the top of the spray tank, and they much prefer the latter. This system only requires two men, one to do the spraying from the tank and the other to drive the tractor. The machine is kept moving all the time, slowly for large trees and faster for small ones. It makes a round trip for each row; goes up one side and back on the other, spraying the trees from both directions. A "broom" type of gun with six nozzles is used, and the regulator set so that the pressure reads approximately 400 pounds on the pressure guage.

If the peach orchard is set in an open field away from woods, creek banks, and ditch banks, which provide good hibernation quarters for curculio, good control of peach pests is usually much easier to obtain. If the infested fruits and the "drops" and young fruits removed in thinning are also destroyed, the pest infestation of the orchard is likewise reduced.

Refer to the Mississippi Spray Calendar for details on the materials to use for specific pests and the proper times of application.

SUMMARY

(1) Peaches can be successfully grown in the Yazoo-Mississippi Delta on good soils. The trees are usually propagated by budding on Tennessee peach seedlings.

(2) The orchard should be located near the dwelling of the attendant and should be on well-drained soil. The young peach orchard should not be set immediately on an old site.

(3) Not more than 10 or 12 varieties would be desired in a home orchard and less than this number in commercial plantings. Some of the newer varieties are recommended, and others look very promising

(4) Young, vigorous, either "June-budded" or "year-old" trees should be used, and they should be set in the orchard or "heeled in" immediately upon arrival. They should be set during the dormant season. Mid-winter is a good time for the planting. Trees should be set 2 or 3 inches deeper in the orchard than they grew in the nursery.

(5) Cultural studies at the Delta Experiment Station indicate that peaches must be cultivated for best results in the Delta area. Cultivation of peaches in this locality seems to be as essential as cultivation of cotton. Peach trees grown in sod did very poorly at Stoneville. A low-growing crop may be grown between the young peach rows until the trees come into production

(6) Peach trees in the fertile Delta soils seem to respond only to nitrogen fertilizer. This may be supplied with applications of mineral nitrogen fertilizer or by growing a crop of bur clover each year in the orchard.

(7) Pruning during the first two years in the orchard consists entirely of training the young trees. This may be done mostly during the growing season but some may also be done in the dormant period. Pruning of the bearing trees consists mostly of thinning out the weak and thick branches, and this is done almost entirely in the dormant season. Old trees may sometimes need heading back to encourage new growth.

(8) Fruit thinning is a practical process and it often is necessary in order to produce large fancy fruit.

(9) That portion of the crop used for eating fresh or home freezing may be harvested when soft or tree ripened, but the bulk of the crop that is handled commercially must be picked when 'firm ripe" in order to handle it. The crop must be handled with care at all times to avoid bruising.

(10) Thorough application of adapted insecticides and fungicides at the proper times, is most essential in the control of peach disease and insect pests. A good spray machine is necessary to do a satisfactory job of spraying and workers at the Delta Station prefer making the application with the operator standing on top of the spray tank provided a large machine is used. Refer to the Mississippi Spray Calendar for details on the time of application and materials to use.

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Cotton Varieties
in the
Yazoo-Mississippi Delta
1944-1946

By
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COTTON VARIETIES IN THE YAZOO-MISSISSIPPI DELTA

By JAMES B. DICK and SIDNEY G. BRAIN

Cotton variety tests have been conducted for many years by the Delta Branch Station at Stoneville and upon plantations in representative sections of the Yazoo-Mississippi alluvial area to obtain information concerning the relative performance of the leading varieties with production conditions approximating those under which cotton is grown in the Delta. A continuous effort is made to adapt the variety tests to the current needs of producers, buyers, spinners, and oil mill operators, and to furnish information to all who are interested in the characteristics of the varieties of cotton tested.

More attention is being given to the spinning quality of cotton than ever before. Fiber properties which influence yarn strength and spinning quality most are length, tensile strength, and uniformity. These properties are reported upon, as in the three previous years. Other characteristics which have been determined are: Yield of seed cotton and of lint in pounds per acre, gin turn-out, number of bolls required to make a pound of seed cotton, earliness, and total money value per acre based upon Middling, Strict Low Middling, and Low Middling grades.

The yields of seed cotton are based upon the weights harvested from ten one-row plots at each location each season. The yields of lint are based upon the respective yields of seed cotton and gin turn-outs.

Gin turn-out values are the results of ginning ten 100-boll samples from each variety for each location.

The staple lengths of each variety for each location are determinations by classers of the State Cotton Cooperative Association, Greenwood, Mississippi, and of the Greenwood Office of the Board of Cotton Examiners, Production and Marketing Administration, U. S. Department of Agriculture.

The sizes of bolls are based upon the average weight of ten 100-boll samples from each variety at each location.

The percentage of cotton from the first picking, which is considered a measure of earliness, is calculated by dividing the weight of the first picking by the weight of the total production.

The fiber tensile strength and the length uniformity of fiber are the findings from tests made of these cottons in the Knoxville Laboratory of the Division of Cotton and Other Fiber Crops, U. S. Department of Agriculture.

The money values per acre are based upon: (1) Yields of seed and lint, (2) staple lengths, and (3) seed grades. The values for three grades—Middling, Strict Low Middling, and Low Middling—are given. The average prices for cotton of the respective grades and several lengths are for 10 weeks of the 1946 marketing season, Memphis market. The seed is evaluated upon a basis of $70 per ton, with premiums and discounts in accordance with official standards for grading cottonseed set up by the U. S. Department of Agriculture. The seed analyses were made by the Barrow-Agee Laboratory, Inc., Leland, Mississippi.

Differences representing significance between varietal averages for each of the characteristics are included in the bottom two lines of the tables. To be considered significant, the differences between any two varietal averages in a column must be greater than the item designated as "barely significant."

Rainfall was ample at each test location and original stands for the 1946 tests were good to excellent. Abnormally high rainfall during the early growing season was followed by a dry, late growing season and an excellent harvesting season.

The current report is divided into two parts: (1) The 1946 tests, and (2) the average of 2- and 3-year tests at the same location.

Table 1. Stoneville cotton variety test, 1946.

Variety	Yield per acre		Gin turnout	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Stoneville 2B	2325	746	32.1	35.3	63.6	43.9	79,300	86.6	329	320	289
Deltapine 15	2073	752	36.3	34.8	76.7	47.6	77,700	86.9	318	309	279
Delfos 9169	2140	695	32.5	35.0	67.5	44.0	77,200	84.7	307	298	270
Coker 100-Staple ('46)	2116	694	32.8	35.8	72.6	39.6	77,700	85.8	304	296	266
Coker 100-Wilt ('46)	2053	663	32.3	35.1	73.2	42.7	77,400	87.0	290	282	254
Bobshaw 1	2054	649	31.6	34.8	69.9	45.3	80,600	86.7	286	278	252
Miller	2003	657	32.8	32.2	65.7	39.6	73,100	87.8	283	275	248
Bobdel	2059	622	30.2	35.4	74.6	55.9	81,200	84.4	280	273	247
Delfos 651	1969	624	31.7	35.5	77.4	43.7	76,600	84.4	279	271	245
Delfos 444	2077	588	28.3	36.0	81.9	50.1	71,200	84.7	270	263	237
Delfos 531C	1905	587	30.8	35.8	80.3	55.1	77,200	82.9	267	259	233
Wilds ('46)	1649	475	28.8	39.9	70.2	33.8	86,600	84.5	242	228	196
Dif. barely significant	141	45	.4	.4	1.7	4.2	2,000	2.3	20	20	17
Dif. highly significant	186	59	.6	.6	2.3	5.5	2,800	3.1	27	26	23

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Table 2. Tunica cotton variety test, 1946.

Variety	Yield per acre		Gin turnout	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobshaw 1	2529	875	34.6	34.7	69.6	35.5	87,100	86.8	377	366	331
Coker 100-Staple ('46)	2430	853	35.1	35.8	75.8	33.5	85,000	85.5	369	358	321
Coker 100-Wilt ('46)	2397	853	35.6	34.8	70.5	37.4	84,200	87.5	363	353	318
Miller	2358	861	36.5	32.5	65.0	34.9	83,100	87.6	361	351	316
Delfos 651	2391	815	34.1	35.1	74.8	37.1	85,300	85.5	356	346	312
Stoneville 2B	2356	815	34.6	35.0	65.1	26.9	84,800	85.1	351	341	308
Delfos 9169	2217	785	35.4	35.5	66.6	28.6	83,300	85.6	340	330	297
Wilds ('46)	2200	678	30.8	40.5	73.0	46.2	94,500	86.0	342	321	273
Deltapine 15	1999	794	39.7	34.5	80.6	26.1	84,200	88.2	326	317	285
Bobdel	2193	706	32.2	34.9	72.7	47.3	89,300	85.4	311	303	274
Delfos 531C	2025	670	33.1	35.5	77.9	41.7	81,000	84.9	297	288	260
Delfos 444	2015	613	30.4	36.0	81.8	46.1	78,500	87.2	279	270	243
Dif. barely significant	189	65	.4	.5	2.6	5.5	3,300	2.6	29	28	25
Dif. highly significant	251	86	.6	.7	3.5	7.3	4,500	3.5	38	37	33

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Results of the 1946 Variety Trials

The 1946 variety trials were located at Stoneville, Tunica, Jonestown, Money, Valley Hill, Yazoo City, and Kelso Plantation, Cary, Mississippi. There are 12 varieties of cotton included. Most of them are grown commercially in the Delta.

In each test the varieties are arranged according to the average of the money value per acre for the 3 grades: Middling, Strict Low Middling, and Low Middling.

Stoneville Test

The Stoneville test was located at the Delta Branch Experiment Station. The soil is a sandy loam, typical of the banks along upper Deer Creek. A nitrogenous fertilizer was "bedded on" about 2 weeks before planting. The test was planted on April 21. The first picking was made September 9, and the second picking on October 24. Results of the test are given in table 1.

The leading varieties in the Stoneville test, based upon the average of the rankings of money value per acre for Middling, Strict Low Middling, and Low Middling grades were Stoneville 2B, Deltapine 15, Delfos 9169, and Coker 100-Staple (1946). There was no difference in ranking of varieties for the 3 grades.

Tunica Test

In cooperation with E. G. (Gene) Johnson, landowner, and H. J. Vickery, County Agent, a variety test was conducted in the northern part of the Delta in Tunica County, 9 miles south of Tunica on Highway 61. The test was on Forrestdale silty loam soil, classification number 425, commonly known as white oak or white sandy land. A nitrogenous fertilizer was "bedded on" and the test planted on April 23. Excessive rainfall during May damaged the test to a limited extent. Favorable conditions during June and July were followed by a hot, dry August. The plants were small but well fruited. The first picking was made on September 11, and the second picking on October 22. Results of the Tunica test are given in table 2.

The leading varieties were Bobshaw 1, Coker 100 Staple, Coker 100 Wilt, Miller, Delfos 651, and Stoneville 2B.

Jonestown Test

The test near Jonestown was conducted in cooperation with Carey Cocke, Jr., farm operator, and Harris Barnes, County Agent of Coahoma County, and was located on the Eagle Nest Plantation west of Jonestown. The soil is a sandy loam, generally well drained. A nitrogenous fertilizer was "bedded on" and the test planted on April 22. Excessive rains in June damaged the west end of the test and dwarfed the plants. Growth throughout the balance of the test was rank with considerable boll rot. Pathogenic wilt was present but was probably of little consequence. The first picking was made October 8, and the second picking on December 16. Results of the Jonestown test are given in table 3.

The varieties with highest average rankings are Deltapine 15, Coker 100 Staple, Stoneville 2B, Coker 100 Wilt. Miller, and Bobshaw 1.

Money Test

The Money variety trial was conducted in cooperation with H. L. Gary, president of Wildwood, Inc. The test was located on the east banks of the Tallahatchie River on Wildwood Plantation. The soil is a fine sandy loam and is well drained. A nitrogenous fertilizer was "bedded on" and the test planted April 26. Stands were very good. Boll weevils were plentiful late in the season. Heavy rains caused excessive growth and reduced yields considerably. The first and second pickings were made on September 20 and October 31, respectively. The results of the test conducted at Money are given in table 4.

Leading varieties in the Money test were Delfos 651, Bobshaw 1, Stoneville 2B, and Delfos 9169.

Table 3. Jonestown cotton variety test, 1946.

	Yield per acre								Total money value per acre		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict low mid-dling	Low mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Deltapine 15	2054	754	36.7	34.2	73.7	41.0	74,200	79.5	318	309	279
Coker 100-Staple ('46)	2195	700	31.9	35.7	71.8	36.3	75,800	79.0	311	301	270
Stoneville 2B	2166	691	31.9	34.6	63.2	34.5	77,900	77.8	305	296	269
Coker 100-Wilt ('46)	2121	674	31.8	34.5	70.8	30.4	73,400	83.1	295	286	259
Miller	2039	675	33.1	32.6	63.0	33.1	71,200	83.8	291	283	255
Bobshaw 1	2108	643	30.5	33.9	67.0	34.9	76,600	81.1	285	277	252
Delfos 9169	2021	631	31.2	34.9	66.4	35.0	76,300	78.4	280	273	247
Delfos 651	1947	594	30.5	35.2	75.8	38.0	75,800	76.1	268	261	236
Delfos 444	1839	506	27.5	35.5	80.9	45.0	69,800	75.9	234	228	207
Delfos 531C	1715	516	30.1	35.5	76.5	39.6	73,900	74.7	234	228	206
Wilds ('46)	1647	476	28.9	38.6	67.1	31.0	86,000	75.1	239	225	195
Bobdel ...	1679	502	29.9	34.6	72.6	46.1	78,300	80.7	225	219	199
Dif. barely significant	232	72	.6	.5	2.6	5.6	2,000	3.3	33	31	28
Dif. highly significant	307	95	.8	.7	3.5	7.5	2,800	4.4	43	42	37

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Table 4. Money cotton variety test, 1946.

	Yield per acre								Total money value per acre		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict low mid-dling	Low mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Delfos 651	1815	554	30.5	35.9	78.5	66.4	81,000	85.3	251	244	220
Bobshaw 1	1784	558	31.3	34.9	70.5	61.3	83,700	86.5	245	239	216
Stoneville 2B	1667	527	31.6	35.3	69.1	63.6	82,600	84.5	231	225	203
Delfos 9169	1643	519	31.6	35.9	71.6	65.1	80,100	86.1	232	224	202
Coker 100-Wilt ('46)	1469	458	31.2	35.2	76.7	51.0	80,400	86.8	201	196	177
Coker 100-Staple ('46)	1414	450	31.8	36.2	77.8	60.3	81,700	86.8	199	193	173
Delfos 531C	1434	427	29.8	36.7	83.3	74.5	79,600	84.9	199	191	170
Delfos 444	1509	406	26.9	36.6	83.4	65.5	77,200	85.6	191	184	165
Miller ...	1334	436	32.7	33.2	69.7	60.3	78,300	88.9	187	182	165
Deltapine 15	1172	417	35.6	35.1	86.5	77.7	83,700	88.1	176	171	153
Bobdel	1268	364	28.7	35.5	78.6	74.7	85,000	87.5	164	160	145
Wilds ('46)	853	235	27.5	40.3	75.7	56.7	90,900	84.2	121	114	97
Dif. barely significant	178	58	.5	.4	3.5	5.5	2,000	1.8	25	25	22
Dif. highly significant..	236	77	.7	.6	4.6	7.3	2,800	2.4	34	32	29

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Table 5. Valley Hill cotton variety test, 1946.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Total money value per acre		
	Seed cotton	Lint							Mid-dling	Strict low mid-dling	Low mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Stoneville 2B	1676	561	33.5	34.7	64.7	63.7	83,300	85.2	243	236	214
Miller	1611	556	34.5	32.9	64.9	62.5	81,000	84.9	237	230	209
Bobshaw 1	1626	545	33.5	33.9	74.7	59.4	88,200	87.4	235	229	207
Delfos 9169	1613	534	33.1	35.4	66.4	65.5	80,400	85.5	235	228	206
Coker 100-Staple ('46)	1539	511	33.2	35.9	72.1	54.7	83,100	85.4	224	218	195
Deltapine 15	1381	515	37.3	35.1	76.6	62.7	83,100	84.8	215	209	188
Delfos 651	1417	453	32.0	35.2	74.3	63.7	80,600	84.7	201	196	177
Coker 100-Wilt ('46)	1390	453	32.6	35.0	71.0	54.7	81,700	84.8	198	192	173
Delfos 444	1432	410	28.6	36.6	81.0	69.5	75,800	84.3	192	184	165
Bobdel	1347	411	30.5	35.3	73.2	68.9	86,400	86.0	184	179	162
Delfos 531C	1155	359	31.1	36.1	76.9	71.5	80,600	84.4	162	158	142
Wilds ('46)	1085	321	29.6	40.0	72.4	53.8	91,800	84.4	162	153	131
Dif. barely significant	142	46	.4	.5	2.1	4.7	2,600	2.3	20	20	18
Dif. highly significant	188	60	.6	.6	2.8	6.2	3,400	3.1	27	26	23

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Table 6. Yazoo City cotton variety test, 1946.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Fiber tensile strength	Fiber length uni-formity	Total money value per acre		
	Seed cotton	Lint						Mid-dling	Strict low mid-dling	Low mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Coker 100-Staple (1946)	1725	555	32.2	35.9	68.6	76,900	84.4	246	239	215
Delfos 9169	1749	544	31.1	35.2	63.7	77,400	82.8	244	238	215
Stoneville 2B	1693	528	31.2	34.7	62.0	81,500	83.8	235	229	207
Delfos 651	1516	462	30.5	35.7	71.7	77,900	84.0	210	204	184
Bobshaw 1	1544	469	30.4	34.6	67.6	78,800	84.6	209	204	185
Delfos 531C	1511	450	29.8	36.2	72.3	77,400	83.1	208	201	181
Deltapine 15	1332	486	36.5	34.8	71.1	80,100	84.7	206	200	180
Coker 100-Wilt (1946)	1469	457	31.1	35.3	66.7	77,700	84.5	203	197	178
Delfos 444	1560	434	27.8	35.9	76.0	73,600	84.7	203	197	177
Miller	1401	461	32.9	32.6	61.9	73,900	86.5	199	194	175
Bobdel	1438	417	29.0	35.8	69.9	82,800	84.8	191	186	168
Wilds (1946)	1066	306	28.7	40.1	66.5	89,600	80.9	157	147	126
Dif. barely significant	185	58	.4	.5	1.7	3,100	3.2	26	25	23
Dif. highly significant	245	77	.6	.7	2.3	4,200	4.2	35	34	30

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Valley Hill Test

In cooperation with L. S. Hemphill, landowner, a test was conducted at Valley Hill in Carroll County about 6 miles east of Greenwood on Highway 82. The test is located at the eastern border of the Delta and is on a light colored, well drained silt loam made up of outwash from the hills. A nitrogenous fertilizer was "bedded on" before planting. The test was planted April 19. Good stands were obtained on most varieties but early "damping off" of seedlings resulted in irregular stands. However, later counts showed an average stand for all varieties. Damage from pathogenic wilt was severe on the Delfos 531C and Delfos 444 varieties. Coker 100 Wilt and Miller were highly resistent to the wilt. Boll weevil infestation was heavy, and the yield of all varieties was affected. First and second pickings were made on September 19 and October 29, respectively. The results of the Valley Hill test are given in table 5.

Stoneville 2B, Miller, Bobshaw 1, Delfos 9169, and Coker 100 Staple were the leading money-value-per-acre producers in the Valley Hill test.

Yazoo City Test

In cooperation with Marx Schaefer, landowner, and A. R. Ruby, County Agent, the Yazoo City variety trial was conducted on the Schaefer Farm 3 miles west of Yazoo City. The soil is a fine sandy loam and is well drained. A nitrogenous fertilizer was "bedded on" and the test planted on April 18. The plants grew tall and the foliage was very heavy. Boll weevils appeared early and caused serious damage to all varieties, entirely destroying the top crop. The entire prduction was harvested on September 30, and no data on "earliness" are available. Results of the Yazoo City test are given in table 6.

Leading average money value producers were Coker 100 Staple, Delfos 9169, and Stoneville 2B.

Kelso Test

The Kelso test was conducted in cooperation with James Hand of Kelso Plantation and C. L. Cary, County Agent of Sharkey County. It is located on the Sharkey-Issaquena county line 11 miles south of Cary on Highway 61. The soil is very productive fine sandy loam, well drained, and typical of lower Deer Creek soil. The test was planted in check rows on April 29. The rows were 40 inches apart each way and were cultivated with four-row equipment throughout. Six plants were left in each hill. Excessive rains occurred during the early season and the boll weevil infestations were very heavy. The plants were tall with rank foliage. Considerable boll rot occurred. The cotton was late in opening, and the entire production was picked on November 22. No data on earliness were available. Results of the Kelso test are given in table 7.

Deltapine 15, Stoneville 2B, Coker 100 Staple (1946), and Miller were the highest ranking varieties in total value per acre.

Averages of Results from 2- and 3-Year Variety Studies

The yield of cotton is greatly affected by seasonal conditions. Average results of the several variety tests conducted at different locations in the Delta in any one year provide interesting and useful information on some varietal characteristics. It is believed that the average results of tests conducted over a period of several years in a given locality provide the grower in the vicinity of the test or farming on a similar soil type, with more reliable information on the behavior of a variety under average conditions Average results of tests conducted at the same locality during the years from 1944 to 1946 are given.

Variety trials similar to those described above were conducted during the 3 years, 1944 to 1946, at Stoneville,

Table 7. Kelso cotton variety test, 1946.

Variety	Yield per acre		Gin turnout	Staple length	Bolls per lb. seed cotton	Fiber tensile strength	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint						Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Deltapine 15	1361	498	36.6	34.4	75.3	76,100	81.1	211	205	185
Stoneville 2B	1484	476	32.1	34.6	64.2	78,500	80.4	210	204	185
Coker 100-Staple (1946)	1416	462	32.6	35.4	72.8	75,800	81.6	203	197	178
Miller	1334	456	34.2	32.6	66.0	73,600	84.5	195	190	172
Delfos 9169	1351	426	31.5	35.0	65.9	76,600	79.3	189	184	167
Coker 100-Wilt (1946)	1342	433	32.3	34.4	72.1	75,000	82.9	189	184	166
Delfos 531C	1371	410	29.9	35.2	76.4	75,600	78.8	187	182	165
Bobshaw 1	1338	421	31.5	34.2	71.4	79,600	82.5	186	181	164
Wilds (1946)	1307	380	29.1	38.5	69.3	88,000	83.0	190	180	156
Delfos 444	1430	400	28.0	35.2	81.4	73,100	80.1	184	179	163
Delfos 651	1297	405	31.2	35.0	77.3	77,900	80.2	182	177	160
Bobdel	1273	386	30.3	34.9	73.3	81,700	80.4	173	169	153
Dif. barely significant	134	30	.6	.5	2.4	2,600	2.4	18	18	16
Dif. highly significant	177	53	.8	.7	3.2	3,400	3.2	24	23	21

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Table 8. Yield and other data from cotton variety tests Stoneville; 3-year averages, 1944-46.

Variety	Yield per acre		Gin turnout	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Stoneville 2B	2662	902	33.9	35.3	62.7	40.6	82,000	82.2	314	297	262
Deltapine**	2364	910	38.5	34.7	74.0	39.9	77,900	84.1	297	282	250
Coker 100*	2435	850	34.9	35.6	69.5	40.3	80,000	80.7	296	278	242
Bobshaw 1	2477	832	33.6	34.7	68.4	44.2	83,500	83.4	281	268	239
Miller	2469	864	35.0	32.0	62.4	42.9	77,500	85.5	275	265	238
Bobdel	2405	765	31.8	35.4	71.5	52.4	84,200	82.1	270	258	228
Delfos 651	2284	747	32.7	35.9	76.1	45.2	78,800	79.8	275	257	223
Delfos 444	2463	722	29.3	36.3	81.4	46.1	75,100	81.7	273	255	221
Delfos 531C	2262	722	31.9	36.3	78.0	50.7	78,800	78.9	271	253	218
Wilds***	2007	622	31.0	40.2	69.7	35.4	89,600	79.9	264	241	191

*Coker 100-8 in 1944; Coker 100-Staple Str. 1 in 1945; Coker 100-Staple (1946) in 1946.

**Deltapine 14 in 1944 and 1945; Deltapine 15 in 1946.

***Wilds 16 in 1944, Wilds 17 in 1945, Wilds (1946) in 1946.

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Money, Valley Hill, Yazoo City, and Kelso, and during the years 1945 and 1946 at Jonestown. The 1946 test near Tunica was on Forrestdale silty loam soil, and was several miles south of the land on which the 1944 test was conducted. The 1944 test was on Dundee silt loam. The 1944 and 1946 tests are averaged to obtain the results and are shown in table 9.

Methods used in conducting the tests, collecting samples, and analyzing data were the same as outlined for the 1946 tests. Descriptions of the 1944 and 1945 tests, with results of each test, are given in bulletins 416 and 435 of the Mississippi Agricultural Experiment Station. The 1946 tests were described earlier in this report.

The 1944 growing season in the Yazoo-Mississippi Delta was characterized by a marked deficiency of soil mois-

Table 9. Yield and other data from cotton variety tests Tunica; 2-year averages, 1944 and 1946.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Total money value per acre		
	Seed cotton	Lint							Mid-dling	Strict low mid-dling	Low mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobshaw 1	2187	741	33.9	35.0	67.5	36.9	82,900	82.9	282	270	242
Coker 100*	2097	738	35.2	35.8	72.2	39.7	80,500	81.6	281	268	236
Stoneville 2B	2143	731	34.1	35.2	62.2	34.9	81,000	81.9	276	263	234
Miller	1990	720	36.2	32.7	61.7	43.3	78,800	85.3	260	251	226
Deltapine**	1862	728	39.1	35.0	78.2	32.4	79,600	84.3	262	249	221
Delfos 651	1948	643	33.0	35.6	73.0	40.3	80,700	82.1	257	246	218
Wilds***	1823	565	31.0	40.5	70.4	47.4	90,600	81.7	258	239	196
Bobdel	1938	612	31.6	35.5	71.4	48.4	84,700	84.0	243	231	205
Delfos 531C	1904	617	32.4	35.9	75.8	44.2	78,000	81.0	243	231	204
Delfos 444	1912	551	28.8	36.3	80.8	45.4	75,100	83.0	227	215	189

*Coker 100-8 in 1944 and Coker 100-Stable (1946) in 1946.

**Deltapine 14 in 1944 and Deltapine 15 in 1946.

***Wilds 16 in 1944 and Wilds (1946) in 1946.

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Table 10. Yield and other data from cotton variety tests Jonestown; 2-year averages, 1945 and 1946.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Total money value per acre		
	Seed cotton	Lint							Mid-dling	Strict low mid-dling	Low mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Coker 100-Staple*	1807	585	32.4	36.4	71.0	53.6	78,300	75.6	237	225	196
Deltapine**	1672	624	37.3	34.9	75.2	52.6	76,000	78.5	234	224	200
Delfos 9169	1806	578	32.0	35.4	65.1	53.6	76,800	76.4	226	216	193
Bobshaw 1	1867	579	31.0	34.6	66.4	53.5	79,600	78.6	224	215	194
Stoneville 2B	1769	571	32.3	35.0	62.7	51.1	79,100	76.4	224	215	193
Miller	1801	605	33.6	32.8	60.7	49.4	74,100	80.8	223	215	193
Delfos 651	1673	512	30.6	35.9	73.4	57.9	77,100	74.8	209	199	177
Bobdel	1651	495	30.0	35.5	71.2	61.1	80,800	78.6	198	188	166
Delfos 531C	1577	481	30.5	36.2	75.5	57.8	76,100	73.7	196	186	154
Delfos 444	1602	434	27.1	36.4	80.0	60.4	72,100	74.7	186	177	155
Wilds***	1274	372	29.2	39.8	66.6	36.7	86,200	75.2	175	162	135

*Coker 100-Staple Str. 1 in 1945; Coker 100-Staple (1946) in 1946.

**Deltapine 14 in 1945; Deltapine 15 in 1946.

***Wilds 17 in 1945; Wilds (1946) in 1946.

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

ture during the boll-maturation period. The staple lengths of all varieties were shorter than normal. Excessive amounts of rainfall during the planting, growing and harvesting seasons occurred at all locations in 1945. The amount of rainfall during the early 1946 growing season was generally excessive, followed by a dry late growing season and excellent harvesting season. Staple lengths were about normal.

The yield of seed cotton and lint, gin turn-out, staple length, boll size, earliness, fiber tensile strength, uniformity of fiber length, and total money values, based upon Middling, Strict Low Mid-

Table 11. Yield and other data from cotton variety tests Money; 3-year averages, 1944-46.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobshaw 1	2091	686	32.8	35.0	68.3	58.2	80,600	80.9	235	224	199
Stoneville 2B	2049	680	33.2	35.3	63.9	58.4	80,600	79.0	234	222	196
Delfos 651	1939	615	31.7	36.1	73.9	62.0	79,000	77.5	229	214	187
Coker 100*	1781	609	34.2	35.9	71.6	55.2	78,200	78.3	212	198	173
Deltapine**	1697	643	37.9	34.9	77.7	59.0	78,000	82.4	207	196	173
Delfos 531C	1807	567	31.4	36.3	77.2	65.2	77,700	77.7	209	195	170
Delfos 444	1942	546	28.1	36.6	80.1	60.1	73,700	78.8	207	194	168
Miller	1754	609	34.7	32.7	63.1	58.3	76,500	83.5	193	186	167
Bobdel	1727	523	30.3	35.4	72.6	65.2	83,000	81.1	185	175	155
Wilds***	1284	380	29.6	40.2	70.2	50.4	88,500	78.2	161	147	116

*Coker 100-8 in 1944; Coker 100-Staple Str. 1 in 1945; Coker 100-Staple (1946) in 1946.

**Deltapine 14 in 1944 and 1945; Deltapine 15 in 1946.

***Wilds 16 in 1944; Wilds 17 in 1945. Wilds (1946) in 1946.

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Table 12. Yield and other data from cotton variety tests Valley Hill; 3-year averages, 1944-46.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking ****	Fiber tensile strength	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Stoneville 2B	1287	432	33.6	34.7	64.7	62.4	79,400	78.8	155	148	133
Bobshaw 1	1279	425	33.2	34.1	71.3	63.5	82,500	80.9	151	145	130
Miller	1206	425	35.2	32.5	64.6	62.3	76,600	81.9	145	141	127
Coker 100*	1156	398	34.4	35.5	71.6	63.8	78,100	78.2	144	137	120
Deltapine**	1049	399	38.0	35.0	77.1	57.0	77,700	80.7	138	132	117
Bobdel	1207	371	30.7	35.2	71.6	70.9	82,700	80.4	135	129	115
Delfos 651	1047	333	31.8	35.4	74.5	63.6	77,500	78.5	127	120	107
Delfos 444	1124	320	28.5	36.2	80.4	70.7	72,200	78.4	127	120	105
Delfos 531C	872	275	31.5	36.0	78.8	69.5	76,800	76.5	105	100	88
Wilds***	814	243	29.8	39.8	72.9	57.1	87,900	76.7	106	98	80

*Coker 100-8 in 1944; Coker 100-Staple Str. 1 in 1945; Coker 100-Staple (1946) in 1946.

**Deltapine 14 in 1944 and 1945; Deltapine 15 in 1946.

***Wilds 16 in 1944; Wilds 17 in 1945; Wilds (1946) in 1946.

****Based on 1944 and 1946 tests.

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Table 13. Yield and other data from cotton variety tests Yazoo City; 3-year averages, 1944-46

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking ****	Fiber tensile strength	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Stoneville 2B	2069	697	33.7	34.7	64.5	82.6	79,300	78.7	235	224	199
Coker 100*	1986	695	35.0	35.6	72.1	78.8	76,100	78.5	237	223	195
Deltapine**	1880	729	38.8	34.4	76.1	77.6	76,100	81.4	229	219	194
Bobshaw 1	2033	675	33.2	34.6	69.8	80.0	79,000	80.0	229	218	194
Delfos 531C	1920	614	32.0	35.9	77.9	85.8	76,500	77.0	219	205	180
Delfos 651	1915	617	32.2	35.5	75.1	84.4	76,600	77.8	218	205	181
Delfos 444	1989	575	28.9	35.9	81.9	82.7	72,900	79.5	211	198	173
Miller	1862	655	35.2	32.3	63.3	73.7	74,100	82.6	206	198	178
Bobdel	1799	556	30.9	35.3	73.0	84.7	81,200	79.9	197	187	166
Wilds***	1547	473	30.6	39.9	69.0	74.2	87,500	75.8	203	185	147

*Coker 100-8 in 1944; Coker 100-Staple Str. 1 in 1945; Coker 100-Staple (1946) in 1946.
**Deltapine 14 in 1944 and 1945; Deltapine 15 in 1946.
***Wilds 16 in 1944; Wilds 17 in 1945; Wilds (1946) in 1946.
****Based on 1944 and 1945 tests.

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

Table 14. Yield and other data from cotton variety tests Kelso; 3-year averages, 1944-46.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking ****	Fiber tensile strength	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Stoneville 2B	1747	573	32.8	35.0	64.0	73.8	77,200	77.8	201	189	168
Delfos 531C	1713	528	30.8	35.8	76.6	82.5	74,300	75.3	196	184	161
Coker 100*	1638	550	33.6	35.6	72.1	76.4	74,900	77.6	193	182	159
Deltapine**	1493	563	37.7	34.8	75.1	73.9	73,300	79.5	188	179	159
Delfos 651	1636	510	31.2	35.5	76.1	87.9	75,000	76.8	186	175	154
Bobshaw 1	1645	531	32.3	34.5	70.1	81.4	78,100	80.1	182	173	155
Delfos 444	1717	474	27.6	36.0	82.5	70.2	71,000	77.3	182	170	149
Miller	1529	531	34.7	32.8	64.1	78.5	72,600	81.8	173	167	150
Bobdel	1524	471	30.9	35.4	73.1	81.9	79,100	78.5	170	160	141
Wilds***	1364	402	29.5	39.5	68.3	74.7	86,000	78.3	173	159	128

*Coker 100-8 in 1944; Coker 100-Staple Str. 1 in 1945; Coker 100-Staple (1946) in 1946.
**Deltapine 14 in 1944 and 1945; Deltapine 15 in 1946.
***Wilds 16 in 1944; Wilds 17 in 1945; Wilds (1946) in 1946.
****Based on 1944 only.

Varieties are arranged according to the average of the money values for Middling, Strict Low Middling, and Low Middling grades.

dling, and Low Middling grades are given in tables 8 to 14 for the respective locations.

The yields of seed cotton were determined by averaging the seed cotton yields obtained during each of the seasons that the tests were conducted at a given locality. The yield of lint was obtained by multiplying the average gin turn-out by the average yield of seed cotton per acre.

The gin turn-out, the staple length, the number of bolls required for a pound of seed cotton, the percent of seed cotton picked during the first picking, the fiber tensile strength, and the fiber length uniformity ratio, were determined by averaging the values obtained for each variety during the seasons that the tests were conducted at a given location.

The total money values per acre for each grade were obtained by averaging the total money-per-acre values for the 2- or 3- year period for that particular grade for each variety. Money values for Middling, Strict Low Middling and Low Middling grades were averaged, and in each table the varieties are arranged according to these averages.

During the 3-year period, 1944-1946 the leading varieties at Stoneville were Stoneville 2-B, Deltapine, Coker 100, and Bobshaw 1.

Bobshaw 1, Coker 100, Stoneville 2B, Miller and Deltapine were the leading varieties at Tunica for the 2 years, 1944 and 1946.

At Jonestown the leading money-value producing varieties during the 2-year period, 1945 and 1946, were Coker 100 Staple, Deltapine, Delfos 9169, Bobshaw 1, Stoneville 2B and Miller.

Leading varieties at Money for the 3-year period were Bobshaw 1, Stoneville 2B and Delfos 651.

Stoneville 2B, Bobshaw 1, Miller and Coker 100 were leading money-value producers during the 3-year period at Valley Hill.

Leading varieties at Yazoo City for the 3-year period were Stoneville 2B, Coker 100, Deltapine and Bobshaw 1.

At Keso the highest ranking varieties were Stoneville 2B, Delfos 531C, Coker 100 and Deltapine.

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Results of Fertilizer Tests Of Sugarcane in Mississippi During the Period 1941-1946

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RESULTS OF FERTILIZER TESTS OF SUGARCANE IN MISSISSIPPI DURING PERIOD 1941-1946

By I. E. STOKES and T. E. ASHLEY[1]

This report briefly summarizes the results of ten fertilizer tests of sugarcane conducted at three locations in Mississippi during the period 1941 to 1946. The tests were designed[2] to determine the general influence of several sources of nitrogen fertilizer mixtures, and methods of application on yields of cane and sirup per acre rather than a critical evaluation of specific fertilizer practices. However, the data furnish some practical information related to the fertilization of sugarcane under certain soil and climatic conditions in Mississippi. Two varieties, Co. 290 and C. P. 29/116, were used in the tests.

Tests were conducted on farms near Meridian and near Laurel, Mississippi, and on the South Mississippi Branch Station at Poplarville, Mississippi. The most uniform areas of soil available at each location were selected for the tests. A sandy phase of the Susquehanna soil series was utilized for the tests at Meridian; the tests at Laurel were conducted on a Ruston Atwood fine sandy loam soil; and Ruston sandy loam soil was used for the tests at Poplarville. In each case the soil was well drained and characterized by a slightly rolling topography.

Uniform agronomic practices of seedbed preparation, methods of planting, and cultivation were utilized at each location. The rate of planting in all of the tests was two stalks. Tests at Poplarville were planted during the fall season, usually about November 1. Tests at Laurel were planted in the spring, about March 15. One of the tests at Meridian, summarized in table 1, was planted in the spring and the other test at that location, summarized in table 2, was planted in the fall.

Standard commercial fertilizer materials were used in all of the tests. Sources of nitrogen are indicated for each test in tables 1 to 6. Phosphoric acid (P_2O_5) was obtained in each case from 20 percent superphosphate. Potash was obtained in each case from muriate of potash.

Each treatment, in the tests, was replicated three times except in the test at Meridian, summarized in table 2, where the treatments were replicated four times. Plots approximately 1/100 acre were utilized in all of the tests.

A uniform method of applying the fertilizer was followed in all tests. Fertilizer materials were applied during March in all treatments. Where two applications were involved, the second application was applied during the latter part of June. Two applications were involved in all of the experiments except some of the treatments in the tests summarized in tables 1 and 6.

Fall planted cane utilized for most of the tests was off-barred during the early part of March. Fertilizer treatments were then applied by hand in narrow bands on the bottom of the off-bar furrows approximately 3 inches from the cane and covered to a depth of approximately 4 inches by harrowing the soil from the middles. The second application was applied in small furrows about

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[1] I. E. Stokes, Associate Agronomist, Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering. Agricultural Research Administration, U. S. Department of Agriculture. T. E. Ashley, superintendent, South Mississippi Branch Station, Poplarville, of Mississippi Agricultural Experment Station.

[2] Plans for the tests included in this report were prepared by Mr. Lewis A. Hurst, formerly Biochemist in charge of Soil Fertility Investigations, Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture.

Table 1. Results of fertilizer tests on Susquehanna soil (sand); Mrs. George P. Hoffmann's Farm, Meridian, Mississippi.[1]
Variety: C. P. 29/116

Source of nitrogen	Pounds of fertilizer per acre		Plant cane (1)			First year stubble (1)			Second year stubble (1)		
			Average acre yield of cane	Yield of sirup		Average acre yield of cane	Yield of sirup		Average acre yield of cane	Yield of sirup	
	N	P_2O_5		Per ton	Per acre		Per ton	Per acre		Per ton	Per acre
			Tons	Gallons	Gallons	Tons	Gallons	Gallons	Tons	Gallons	Gallons
Phosphorus mixed in the soil; Nitrogen applied in one application[2]											
Cyanamid	60	100	15.00	18.5	277	33.70	17.0	573	32.55	19.0	618
	60	0	10.40	18.7	194	25.33	17.3	438	22.59	16.2	366
Nitrate of soda	60	100	20.40	17.3	354	33.18	18.6	617	31.19	15.9	496
	60	0	16.80	18.6	312	26.11	18.3	478	22.30	18.5	413
Ammonuim sulphate	60	100	19.50	18.6	353	34.14	19.5	666	29.86	18.8	561
	60	0	16.80	19.7	331	30.59	18.8	575	29.25	17.4	509
Cottonseed meal	20	100	12.50	17.9	224	28.47	19.1	544	27.02	18.0	486
	40	100	13.80	19.4	268	28.33	19.1	541	29.44	19.4	571
	60	100	14.60	20.7	302	28.44	19.4	552	29.58	18.1	535
	60	0	15.60	17.9	279	30.76	19.9	612	31.82	17.9	570
	80	100	16.00	20.8	333	29.07	19.3	561	30.57	18.4	562
Phosphorus mixed in the soil; Nitrogen applied in two applications[3]											
Ammonium sulphate	60	100	17.50	20.1	151	31.71	19.3	612	33.49	18.2	610
	60	0	15.60	17.9	279	28.11	19.8	557	28.97	18.8	545
Cottonseed meal	60	100	13.70	19.3	264	29.34	19.7	578	31.69	18.4	583
	60	0	13.00	20.5	266	23.18	19.0	440	23.08	17.3	399
Phosphorus and nitrogen applied in a mixture; one application[2]											
Cottonseed meal	20	100	12.20	18.9	231	25.65	19.1	490	27.32	18.3	500
	40	100	12.20	18.4	224	26.26	18.6	488	26.84	19.7	529
	80	100	16.30	19.0	310	29.87	18.7	559	30.77	17.9	551
	0	100	11.10	18.4	204	24.72	19.4	480	26.17	19.7	516
Check	0	0	10.50	19.0	199	26.00	19.9	517	24.13	19.8	478
Difference:											
For P = .05	—	—	4.36	1.23	94	8.63	0.82	183	11.40	0.83	206
For P = .01	—	—	5.79	1.64	125	11.52	1.09	243	15.16	1.11	274

[1] Numbers in parentheses indicate the number of tests.

[2] Applied in March.

[3] 2/3 applied in March and the remainder in June.

Table 2. Results of fertilizer tests on Susquehanna soil (sand); Mrs. George P. Hoffmann's Farm Meridian, Mississippi.[1]
Variety: C. P. 29/116

Pounds of fertilizer per acre			Plant cane (1)			Second year stubble (1)		
			Average acre yield of cane	Yield of sirup		Average acre yield of cane	Yield of sirup	
N[1]	P_20_5	K_20		Per ton	Per acre		Per ton	Per acre
			Tons	Gallons	Gallons	Tons	Gallons	Gallons
20	40	20	16.68	20.2	336	13.98	20.8	290
40	40	20	18.51	19.2	355	19.33	19.1	370
60	40	20	18.83	19.5	367	20.86	20.3	395
20	80	20	13.58	19.3	263	12.43	20.1	250
40	80	20	20.36	18.1	368	19.18	20.9	401
60	80	20	17.91	18.9	338	21.14	20.1	425
0	0	0	13.14	19.5	257	11.07	19.8	219
Difference								
For $P = .05$			5.99	0.98	125	5.76	3.17	137
For $P = .01$			8.20	1.34	171	7.89	4.34	188

1. Numbers in parentheses indicate number of tests.

[1] Nitrogen from ammonium sulphate.

3 inches from the cane on each side of the rows, the fertilizer being covered immediately to a depth of about 4 inches during the cultivation operation.

A variation from the general procedure described above for applying the fertilizer was followed at Meridian in the test summarized in table 1; prior to the planting operation phosphate (P_20_5) was applied and mixed thoroughly with the soil at a depth of approximately 1 inch below the furrow in which the cane was planted. The method of applying nitrogen in this test was the same as the general procedure described above for other tests.

All of the tests were harvested, in accordance with usual commercial practices, during the period November 1 to 15, except in a few cases where some of the second year stubble tests were harvested during the latter part of October. Yields of cane per acre were based on plot weights of stripped cane. Border rows on each plot were eliminated from plot weights to avoid the influence of border effect from the various fertilizer treatments.

Yields of sirup per ton of cane were based on sirup tests, conducted on a laboratory scale evaporator, that involved composited samples of juice extracted from field samples of from 15 to 25 stalks selected at random from each plot of each treatment.

Discussions

The results of the fertilizer tests summarized in tables 2 to 6, inclusive, show that yields of cane and sirup per acre were improved in each case by the addition of fertilizer except in a single instance (table 6) where half of the fertilizer was applied to second year stubble in March and the remainder in June. Yields observed in all tests no doubt were influenced to some extent by seasonal conditions and by physical conditions and original fertility of the soil.

Results of tests given in table 1 vary, the observed yield of cane and sirup from approximately one-third of the total number of fertilized plots being somewhat lower than yields from the unfertilized check plots. Reason for the lower yields, as compared with increased yields from all other fertilized plots in these tests and increased yields from fertilized plots in other tests, is not apparent. However, the variations in observed yields may have resulted from obscure variations in physical conditions and fertility of the soil throughout the tract of deep

Table 3. Results of fertilizer tests on ruston atwood fine sandy loam soil; C. B. Howse's Farm, Laurel, Mississippi.[1]

Variety: Co. 290

Pounds of fertilizer per acre			Plant cane (1)			First year stubble (1)			Second year stubble (1)		
			Average acre yield	Yield of sirup		Average acre yield	Yield of sirup		Average acre yield	Yield of sirup	
N	P_2O_5	K_2O	of cane	Per ton	Per acre	of cane	Per ton	Per acre	of cane	Per ton	Per acre
			Tons	Gals.	Gals.	Tons	Gals.	Gals.	Tons	Gals.	Gals.
Nitrogen from ammonium sulphate											
32	64	32	24.09	19.1	460	24.47	17.7	433	17.54	19.2	337
64	64	32	25.91	19.0	492	28.29	19.0	538	26.23	18.8	493
96	64	32	25.32	18.6	471	28.08	18.6	522	21.28	16.6	353
Nitrogen from cottonseed meal											
32	64	32	22.93	18.5	424	18.10	17.3	313	15.76	18.9	298
64	64	32	24.57	19.9	489	25.40	20.8	528	23.68	19.0	450
96	64	32	26.52	19.1	307	25.16	18.1	455	21.43	18.5	396
32	128	32	23.46	18.5	434	21.75	16.9	368	17.65	18.3	323
64	128	32	24.00	18.8	451	23.73	18.2	432	22.68	20.0	454
96	128	32	26.68	18.2	486	28.85	16.7	482	25.29	20.2	511
0	0	0	15.21	19.1	291	11.92	20.0	238	7.73	17.2	133
Difference											
For P = .05			5.68	2.26	125	6.79	4.77	214	6.38	2.26	157
For P = .01			8.16	3.25	179	9.75	6.86	308	9.16	3.25	225

1. Numbers in parentheses indicate the number of tests. For example, plant cane tests were conducted in two different years during the six-year period 1941-1946.

Table 4. Results of fertilizer tests on ruston atwood fine sandy loam soil; C. B. Howse's Farm, Laurel, Mississippi.[1]

Variety: C. P. 29/116

Pounds of fertilizer per acre			Plant cane (1)			First year stubble (1)			Second year stubble (1)		
			Average acre yield	Yield of sirup		Average acre yield	Yield of sirup		Average acre yield	Yield of sirup	
N	P_2O_5	K_2O	of cane	Per ton	Per acre	of cane	Per ton	Per acre	of cane	Per ton	Per acre
			Tons	Gals.	Gals.	Tons	Gals.	Gals.	Tons	Gals.	Gals.
Nitrogen from ammonium sulphate											
32	64	32	25.65	17.4	446	24.56	21.9	538	19.49	19.1	372
64	64	32	24.00	17.2	413	32.75	20.8	681	23.28	18.2	424
96	64	32	28.59	15.7	449	34.40	20.1	691	28.11	18.0	506
Nitrogen from cottonseed meal											
32	64	32	21.71	18.5	402	25.84	21.5	556	16.66	19.6	427
64	64	32	21.87	16.7	365	31.23	20.4	637	22.42	19.6	439
96	64	32	29.07	17.0	494	36.29	20.8	755	26.27	19.1	502
32	128	32	21.81	17.4	379	23.15	20.9	484	18.78	18.9	355
64	128	32	27.20	17.1	465	27.50	20.8	572	21.90	18.7	410
96	128	32	28.11	15.0	422	32.96	20.5	676	24.90	18.4	458
0	0	0	16.64	18.5	308	19.23	21.2	408	12.66	19.0	241
Difference											
For P = .05			4.73	0.34	82	6.40	1.19	134	8.39	1.29	155
For P = .01			6.48	0.47	112	8.77	1.63	183	14.50	1.77	212

1. Numbers in parentheses indicate number of tests.

Table 5. Results of fertilizer tests on ruston sandy loam soil; South Mississippi Branch Station, Poplarville, Mississippi.[1]

Variety: C. P. 29/116

Pounds of fertilizer per acre			Plant cane (3)			First year stubble (3)			Second year stubble (2)		
			Average acre yield of cane	Yield of sirup		Average acre yield of cane	Yield of sirup		Average acre yield of cane	Yield of sirup	
N	P_2O_5	K_2O		Per ton	Per acre		Per ton	Per acre		Per ton	Per acre
			Tons	Gals.	Gals.	Tons	Gals.	Gals.	Tons	Gals.	Gals.
			Nitrogen from ammonium sulphate								
20	0	0	26.59	20.2	537	23.73	21.0	498	22.17	21.6	479
40	0	0	28.84	19.8	571	27.12	21.1	572	24.42	21.7	530
60	0	0	28.75	19.5	561	29.69	20.9	621	28.08	21.2	595
80	0	0	26.95	17.8	480	30.23	20.1	608	27.46	20.8	571
20	20	0	24.40	18.6	454	24.19	21.0	508	21.68	20.6	447
40	20	0	26.34	20.2	532	31.75	21.8	692	27.50	20.8	572
60	20	0	34.43	19.2	661	28.81	21.0	605	27.80	21.0	584
80	20	0	27.33	19.4	530	26.65	20.2	538	29.20	21.3	622
20	40	0	26.19	19.7	516	23.90	21.6	516	20.47	20.8	426
40	40	0	28.54	20.5	585	28.36	21.5	610	23.21	22.1	513
60	40	0	31.05	19.6	609	30.30	21.2	642	31.47	21.8	686
80	40	0	31.89	18.7	596	28.16	20.3	572	29.16	21.5	627
80	40	20	28.25	18.9	534	30.87	21.3	658	31.77	21.2	674
0	0	0	20.88	18.8	393	20.35	20.8	423	14.10	21.6	305
Difference											
For $P = .05$			5.18	1.77	106	5.20	1.86	126	13.86	1.99	300
For $P = .01$			7.00	2.39	144	7.03	2.51	171	19.31	2.77	418

1. Numbers in parentheses indicate number of tests. See footnote, table 3.

sandy soil in which the tests were located and in some instances by leaching of the fertilizer by rainfall.

Measurable effects of the fertilizer treatments were more pronounced in the yields of cane per acre and were in turn reflected in yields of sirup per acre. Yields of sirup per ton of cane were not influenced greatly by the fertilizer treatments except in a few cases where high applications of nitrogen resulted in immature cane at the time of harvest which lowered the yields. Yields of cane and sirup per acre improved with successive increases in fertilizer applications within certain general limitations.

The greatest response at each location was associated with the nitrogen applications. Yields of cane and sirup per acre increased with increased applications of nitrogen up to from 40 to 60 pounds per acre. In some cases the increase in yields continued with higher applications of nitrogen, though the proportionate increases were less pronounced from applications above 60 pounds per acre. The response to the nitrogen applications were influenced by seasonal conditions.

Applications of from 96 to 120 pounds of nitrogen as compared to applications of from 40 to 60 pounds of nitrogen per acre, frequently lowered the yields of sirup per ton of cane, but usually resulted in a slight increase in yield of cane and sirup per acre. In some instances applications of nitrogen supplemented by 20 to 40 pounds of P_2O_5 on Ruston sandy loam soil (table 5) resulted in better yields of cane and sirup, but in some other instances applications of nitrogen alone was as effective as when both P_2O_5 and nitrogen were used.

On a Susquehanna soil (sandy phase) near Meridian (table 1) applications of 100 pounds of P_2O_5 per acre as compared with no phosphate resulted in increased

Table 6. Results of fertilizer tests on ruston sandy loam soil; South Mississippi Branch Station. Poplarville, Mississippi.[1]
Variety: C. P. 29/116

Pounds of fertilizer per acre			Plant cane (1)			First year stubble (1)			Second year stubble (1)		
			Average acre yield of cane	Yield of sirup		Average acre yield of cane	Yield of sirup		Average acre yield of cane	Yield of sirup	
N	P_2O_5	K_2O		Per ton	Per acre		Per ton	Per acre		Per ton	Per acre
			Tons	Gals.	Gals.	Tons	Gals.	Gals.	Tons	Gals.	Gals.
			Nitrogen from ammonium sulphate, one application[2]								
20	40	20	19.36	21.6	418	20.68	19.4	401	21.19	19.4	411
60	40	20	24.19	22.9	554	23.41	17.9	419	24.65	17.6	434
			Nitrogen from ammonium sulphate; two applications[2]								
20	40	20	19.56	23.1	452	18.55	19.0	352	15.70	17.4	273
60	40	20	22.07	21.9	483	21.67	19.1	414	20.61	16.7	344
40	80	40	23.40	22.1	517	25.11	20.0	502	27.94	17.8	497
120	80	40	26.05	23.1	602	26.70	20.4	545	25.40	19.3	490
			Nitrogen from cottonseed meal; one application[1]								
20	40	20	20.57	22.8	469	20.57	21.3	438	23.83	18.7	446
60	40	20	22.31	21.9	489	23.38	21.3	498	21.77	18.0	392
			Nitrogen from cottonseed meal; two applications[2]								
20	40	20	19.44	21.1	410	19.19	18.9	363	25.18	16.7	420
60	40	20	27.76	21.7	602	22.07	20.4	450	22.50	18.1	407
40	80	40	22.33	22.8	509	27.71	19.6	543	25.89	16.7	432
120	80	40	24.12	21.5	519	28.25	21.5	607	29.27	17.1	501
60	80	20	22.73	21.8	496	24.44	19.9	486	19.52	18.6	363
0	0	0	18.43	21.6	398	15.63	18.7	292	16.40	18.5	303
Difference											
For P = .05			4.32	2.59	105	5.96	3.67	136	10.04	1.22	188
For P = .01			6.02	3.61	147	8.31	5.12	191	13.44	1.63	252

1. Numbers in parentheses indicate number of tests. See footnote, table 3.

[1] Applied in March.

[2] ½ applied in March and the remainder in June.

yields of cane and sirup per acre. In other tests on that soil, and in tests on other soils, increasing the quantity of P_2O_5 from 40 to 80 pounds or from 64 to 128 pounds per acre without changing the quantities of nitrogen and potash resulted in an increase in yields of cane and sirup in some instances, while in other instances no increase in yield was obtained. The more favorable effect of applying P_2O_5 was in the case of stubble crops.

Inorganic sources of nitrogen were equally as effective as cottonseed meal as measured by the yields of cane and sirup per acre from comparable treatments. In some instances the inorganic sources of nitorgen, ammonium sulphate in particular, resulted in slightly higher yields than comparable treatments where cottonseed meal was used as a source of nitrogen, and in other instances the reverse was the case.

The results as a whole do not show appreciable differences in yields from effect of nitrogen from the inorganic sources used, cyanamid, nitrate of soda, and ammonium sulphate. Although the data (table 1) indicate slightly more favorable effect from P_2O_5 when inorganic sources of nitrogen were used than when cottonseed meal was used, the results are too limited to serve as more than an indication of possible effect.

Summary

1. Inorganic sources of nitrogen (cyanamid, nitrate of soda, and ammonium sulphate) were equally as satisfactory as

cottonseed meal in the total production of a good quality of sirup per acre.

2. Applications of nitrogen, usually from 20 to 60 pounds per acre improved the yields of cane and sirup per acre in essentially all tests; the response depending largely upon the soil type and general fertility of the land. In some of the tests, applications of nitrogen higher than the 60 pounds per acre had a detrimental effect on yield of sirup per ton of cane and on yield of sirup per acre.

Applications of 100 pounds of P_2O_5 per acre as compared to no phosphate on Susquehanna soil (sandy phase) generally improved the yield of cane and sirup per acre. In other tests on that and on the other soils, increasing the quantity of P_2O_5 from 40 to 80 or from 64 to 128 pounds per acre resulted in an increase in yields in some instances and no increase in other instances. The more favorable effect of applying P_2O_5 was in the case of stubble crops.

3. Fertilizer applied in one application in March was as effective as when the same quantity was applied in two applications, one in March and one in June, in most of the tests. Two applications gave better results in some of the second year stubble tests.

4. Because of the widely varying soil types and soil fertility throughout the sugarcane growing area of Mississippi, it is not feasible to recommend kinds and quantities of fertilizer which will prove most suitable under all conditions. In general, based on the results from tests conducted at Meridian, Laurel, and Poplarville, a mixed fertilizer high in nitrogen such as a 6-8-4 (N, P_2O_5, K_2O) should be applied at the rate of from 400 to 800 pounds per acre, depending upon the soil type and previous crop history of the land. Light sandy soils, low in fertility require, in addition to the mixed fertilizer, a supplemental application of from 20 to 30 pounds of nitrogen per acre.

BULLETIN 447 JULY, 1947

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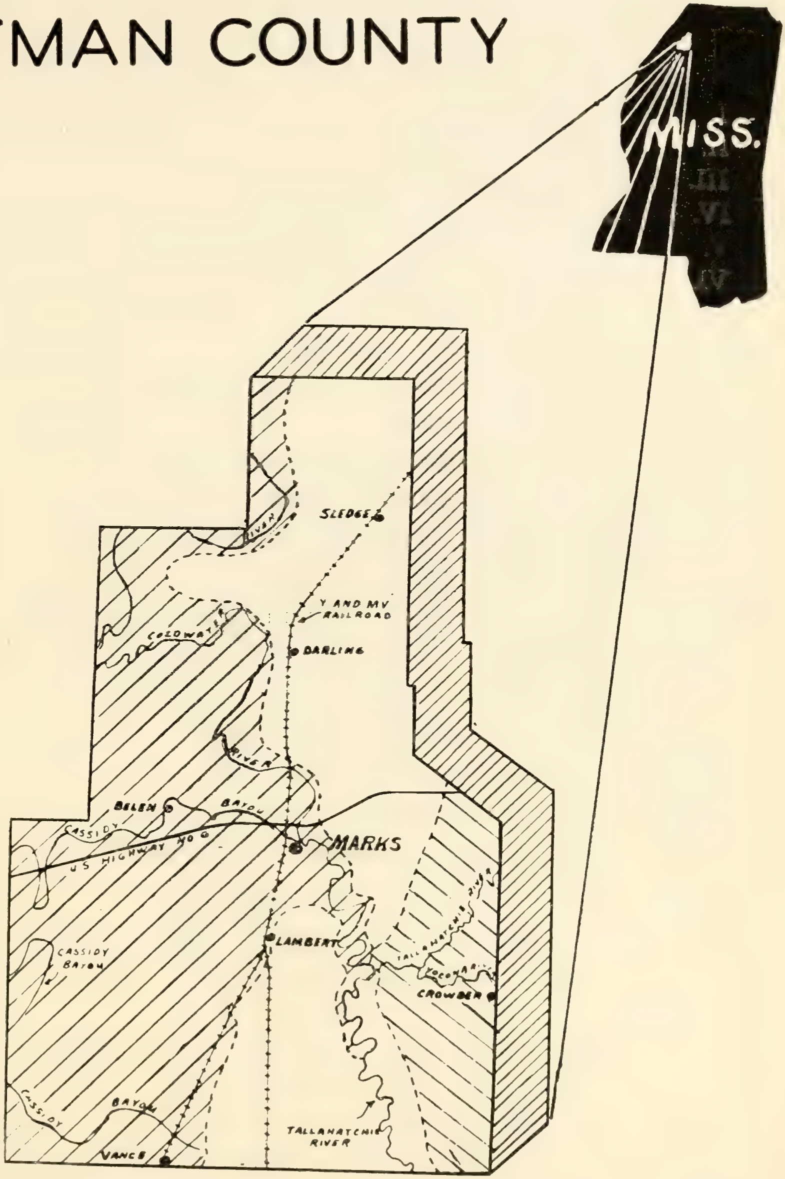
SOIL MANAGEMENT PRACTICES

QUITMAN COUNTY


MISS.
SLEDGE
Y AND MV RAILROAD
DARLING
COLDWATER
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BELEN
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MARKS
LAMBERT
CASSIDY BAYOU
TALLAHATCHIE RIVER
YOCONA RIVER
CROWDER
CASSIDY
BAYOU
VANCE
TALLAHATCHIE RIVER

By

C. G. MORGAN AND H. B. VANDERFORD

AGRICULTURAL EXPERIMENT STATION

MISSISSIPPI STATE COLLEGE
RUSSELL COLEMAN, DIRECTOR
STATE COLLEGE, MISSISSIPPI

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IX. Index 36,37

LAND OWNERS AND OPERATORS OF QUITMAN COUNTY

"DO YOU?" ....

Know your soils?

Know the crops best adapted to your soils?

Know how to establish drainage systems for your farm?

Know the best fertilization and management practices available?

Know how to operate your farm as an enterprise so that you will work with your soils rather than against them?

Know how to treat your land so that you will not mine it of its fertility and force a hardship on future generations?

This bulletin was prepared to help every land owner and farm operator obtain the right answers to the above questions. More detailed information can be obtained from the County Agent, members of the Experiment Station, or representatives of the Soil Conservation Service.

INTRODUCTION

This report contains information both general and specific about the soils and agricultural practices of Quitman County. The main purpose of such a publication is to aid and assist the farmers of this county in making the best use of their land. Every farmer or landowner in the county will be given an individual soil map of his farm, together with this Bulletin which explains and gives the management recommendations for every soil type on the farm. With this information at hand each farmer in Quitman County can adjust the crops best suited to the various soils, establish proper drainage for every field, arrange the rows and locate roads, so that the farm as a whole will be managed in the most profitable manner. The farmers can call on the County Agent and other agricultural leaders for further details and assistance in planning their farm programs and for other information concerning the use of the soils on their farms.

SOIL MANAGEMENT PRACTICES
Recommended for
QUITMAN COUNTY

By C. G. Morgan[1] and H. B. Vanderford

All soils are developed by nature with certain properties so that some are adapted for production of certain crops while others are adapted for growth of other crops, just as some cattle are suitable for the production of meat and others for the production of milk.

The soils of Quitman County are derived from sediments transported by four different streams: the Mississippi River, Coldwater River, Little Tallahatchie River, and the Yocona River, (figure 1). The inherent qualities of the sediments from these various streams and the forces of nature determine the type of soil that is formed. Crop adaptation, drainage, and fertilization vary widely on different soil types.

It is the purpose of the soil survey to study and classify and map these different soils, then provide information that will aid the farmer in making the best practical use of each soil type on his farm.

This bulletin is intended for use with accompanying soil map of the operator's farm. It contains directions for using the soil map, a discussion of general principles of soil management,[2] and a discussion of specific management for each soil type. The soil map shows the location of soil boundaries, the type and slope of soil in each area, roads, houses, ditches, and section lines. The discussion of management covers general soil management problems and describes the best adapted crops, rotations, fertilizers, and other practices for each soil type.

Definitions

Some general definitions and explanations are given to aid and assist the farmers in getting the full benefits of the report.

1. **Alluvium** — material deposited by streams.

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[1] Soil Survey made by Thomas Fowlkes, L. A. Davidson, C. G. Morgan, J. A. Herren, G. E. Rogers, E. J. McNutt, and D. A. Yost, Mississippi Agricultural Experiment Station cooperating with the Department of Agriculture, Bureau of Plant Industry, and Soil Conservation Service.

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[2] Management includes all practices relating to soil use (fertilizers, adapted crops, rotations, drainage, and row direction).

2. **Colluvium** — material deposited by gravity; colluvium is found at the foot of steep slopes or embankments.
3. **Complex** — an area where it is impractical to separate the individual soils because two or more soils are mixed in a complicated pattern or the area is densely wooded.
4. **Depression** — low places where water is slow to drain off or does not drain off.
5. **Escarpment** — a steep bank or "jump off".
6. **Management** — includes all practices relating to soil use such as fertilizers, adapted crops, rotations, drainage, and row direction.
7. **Fallow** — a tillage practice where no crop is grown and the area is plowed frequently to kill weeds.

Explanations

1. The soil map is furnished through the county agent. To find what soils are on any farm or tract of land, the township, range, and section number should be known. Then, by using land marks shown on the map, such as roads, streams, houses and other features, the exact location can be found.

2. Each kind of soil mapped within the farm or tract is marked on the map with a symbol. This symbol is composed of three numbers. The first of the three numbers refers to the position of the soil, the second to internal drainage, and the third to the texture of the surface (sand, silt or clay). For example, an area marked with the symbol 322 is a soil that occupies a low bottom position, has poor internal drainage, and has a clay surface. All areas marked with 322 are the same kind of soil. By looking in the "Legend of Soils" in the index, page 36, it can be seen that 322 refers to the soil type named Sharkey clay.

3. In Quitman County there are ten groups of soils, according to the position and source of material from which they were developed. The soils formed from Mississippi River alluvium are shown on the maps as groups 200 through 400. The soils formed from mixed Mississippi River and Coldwater River alluvium are shown as groups 500 through 800. The soils formed from Little Tallahatchie River and Yocona River are shown as groups T500 through T800. All of these groups are listed blow.

Soils derived from Mississippi River Alluvium

(a) Group 200, depressional soils. These soils occur in low wet places.

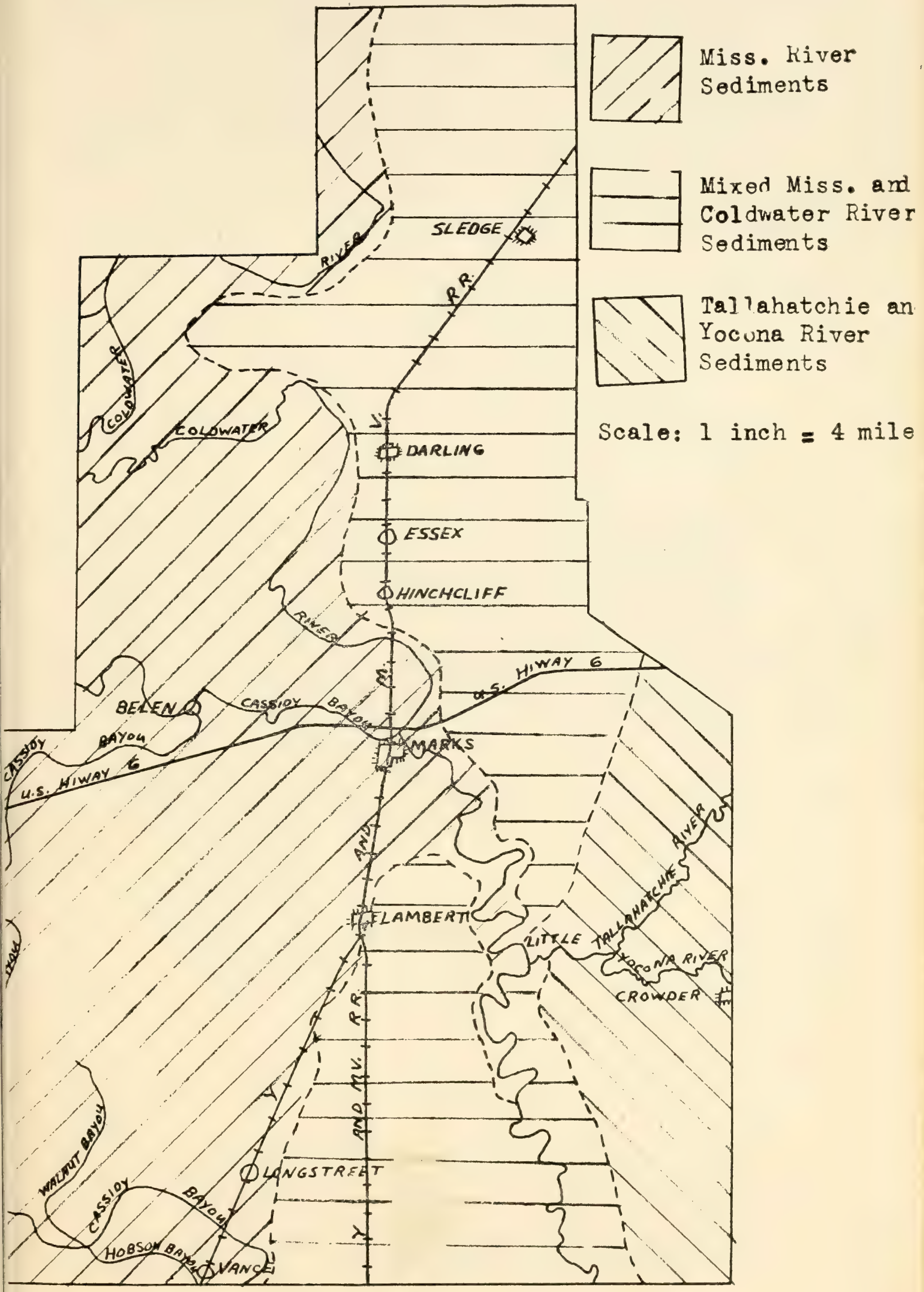

Miss. River Sediments
Mixed Miss. and Coldwater River Sediments
Tallahatchie an
Yocona River Sediments
Scale: 1 inch = 4 mile
SLEDGE
RIVER
R.R.
COLDWATER
COLDWATER
DARLING
ESSEX
HINCHCLIFF
RIVER
U.S. HIWAY 6
BELEN
CASSIDY BAYOU
CASSIDY
BAYOU
U.S. HIWAY 6
MARKS
Y.
M.
AND
LAMBERT
LITTLE TALLAHATCHIE RIVER
YOCONA RIVER
CROWDER
R.R.
AND M.V.
Y.
WALNUT BAYOU
LONGSTREET
CASSIDY
BAYOU
HOBSON BAYOU
VANCE

Figure 1. The Three Main Soil Areas in Quitman County according to source of sediments.

(b) Group 300, low bottom soils. These soils occur in backwater or slackwater areas of the Mississippi River flood plain. They are known locally as "buckshot" soils.

(c) Group 400, low terrace soils. These soils usually occur on the highest elevations in the "delta," generally near old streams or bayous. They are acid in reaction and are known locally as ranging from "sandy soils" to "light buckshot."

Soils Derived from Mixed Mississippi and Coldwater River Alluvium

(d) Group 500, first bottom soils. These soils occur near the Coldwater River and consist of recently deposited alluvium of this stream. Most areas are overflowed frequently and are known locally as "made land".

(e) Group 600, depressional soils. These soils are derived from mixed Coldwater and Mississippi River alluvium and occur in low wet places similar to group 200.

(f) Group 700, low bottom soils. These soils are derived from mixed Mississippi and Coldwater River alluvium and occur in broad areas on the lowest elevations in the county. They are similar to soils in group 300 in most respects except that they overflow more frequently.

(g) Group 800, low terrace soils. These soils are derived from mixed Mississippi and Coldwater River alluvium and occur along the present Coldwater River channel and its tributaries.

Soils Derived from Little Tallahatchie or Yocona River Alluvium

(h) T500, first bottom soils. These soils occur along the Little Tallahatchie or Yocona Rivers and consist of recently deposited alluvium of these streams. Before the present Tallahatchie River Canal was dug, most of the areas were overflowed frequently. These soils are locally known as "made land".

(i) T600, depressional soils. These soils are derived from Little Tallahatchie or Yocona River alluvium and occur in low wet places similar to group 200 soils.

(j) T800, low terrace soils. These soils are derived from Little Tallahatchie and Yocona River alluvium and occur in the southeastern part of the county and are very acid in reaction.

4. There are six degrees of internal drainage recognized in Quitman County, ranging from very poorly drained to ex-

cessively drained. The internal drainage generally governs the amount of surface run-off on a soil.

5. The surface textures found are as follows: clay, silty clay, silty clay loam, silt loam, loam, sandy loam, and loamy sand. The surface texture governs how easily a particular soil is to till.
6. To find what general soil management practices are applicable to all soils in Quitman County see "General Soil Management," page 11.
7. To find the drainage, crop adaptation, rotation and fertilizer recommendations for each individual soil type, see"Management by Soil Type," page 19.

THE SOIL MAP AND ITS USE

The soil map is a complete sketch of the farm, the same size as the AAA aerial photograph (scale 8 inch = 1 mile). It is designed to show all important soil types as well as other material and artificial features such as rivers, bayous, roads, railroads, houses, ditches and section lines. (See "Legend of Symbols on the Soil Map," page 9). On the soil map there are two types of lines to indicate soil boundaries; one, a solid line (see symbol on page 10) which indicates an abrupt change in soil type; and the other, a dotted line (see symbol on page 10) which indicates a gradual change between two soil types. The number inside each separate area on the map is the symbol for the soil type in that area. The letter following a soil number indicates the slope of the soil. (See "Management by Soil Type," starting on page 19, for soil name and recommendations).

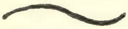
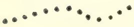
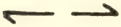
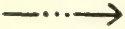
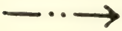
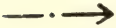
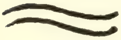
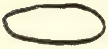
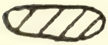
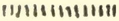
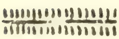
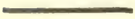
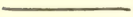
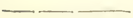
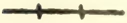
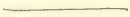
To the individual farmer the soil map has many practical uses. By using the information discussed in this bulletin and suggestions from the County Agent the soil map can be used to help each farmer make more efficient use of the land on his farm. A natural system of secondary drainage can be laid out for each farm by locating ditches in the center of the depressional soils shown on the soil map. By using the soil boundaries on the soil map as field boundaries more uniform field layouts and proper row direction can be determined for each farm. After fields have been laid out by soil types, each farmer can by experimentation determine the proper fertilization for the various soil types on his farm (see County Agent). The soil map can also be used as a base map for locating roads and houses on each farm.

LEGEND OF SYMBOLS ON THE SOIL MAP

457. Soil type number denotes a soil type or complex of types in that area where the number is placed. (See "Management by Soil Type," page 19, for soil type names).

457A. The letter following the soil number indicates the slope of the area. The absence of a letter or the use of A^- shows that the area is depressional (no erosion problem); A° nearly flat (no erosion problem): A, slightly sloping, 1-4 to 2 percent, (very little erosion problem); B^-, used only for colluvial soils occurring at the bottom of slopes (very little erosion problem); B, ridges or gently sloping, 3 percent to 5 percent, (erosion problem); C, sloping, 6 percent to 10 percent (erosion problem); D, steeply sloping, over 10 percent, (erosion problem).

*457A. An asterisk (*) before a soil type number indicates an organic phase of that type. The organic phase is more productive than the normal phase.

	Solid line soil boundary indicates the location of a definite soil change within a space of less than 50 feet (usually a desirable location for a field boundary).
	Dotted line soil boundary indicates a gradual or indefinite soil change within a space of 50 feet or more.
	Tie symbol that connects two areas of the same soil type or phase.
	Small natural drain or low area.
	Shallow artificial ditch not crossable with heavy farm machinery.
	Deep ditch (artificial or natural) not crossable with heavy farm machinery.
	River or large drainageway (artificial or natural).
	Lake containing water all year.
	Intermittent lake that is dry during a portion of the year.
	Earth escarpment or steep embankment too steep for cultivation).
	Levee
	Paved highway
	Gravel highway
	Dirt road or field road
	Railroad
	Section line

Sec. 1	Section number
R. 10 W.	Range symbol
T. 5 S.	Township symbol
— — ——	County line
■	Permanent house
▪	Small house or cabin
✝	Church
⚑	School
▬	Store
▲	Cotton gin
⬆	Indian mound
⊞	Cemetery
⁘	Sandy spot

GENERAL SOIL MANAGEMENT

This discussion of soil management is applicable to all soils in the Quitman County area. It deals with general principles which are fundamental for efficient soil use regardless of the type of soil. Specific recommendations for each soil type are given in "Management by Soil Type" (page 19). Table 1 contains estimates of corn and cotton yields that may be expected on each soil type where good management practices are used continuously. Many of these yields will be exceeded where good management practices are used for a number of years.

Drainage: A system of surface drainage is essential to the proper utilization of the majority of Quitman County soils. Before an extensive system of ditches are dug on any area, the productive capacity, crop adaptation and fertilizer needs of the soil should be considered. It is not economical to drain land when the cost of the ditching exceeds the value of the land.

By using the soil map a system of natural surface drainage can be laid out for each farm provided the main or primary drainage has been provided. All ditches should be located in the natural low depression, and the width and depth of the ditch should be governed by the size of the area which it drains and the soil types occurring within the water shed area. Surface run-off from sandy soils is much less than on heavier soils, therefore small V-shape ditches provide excellent surface drainage.

The cutting of ditches across ridges should be avoided except where it is absolutely essential to drain isolated depressions. The omission of these cross ditches makes possible longer rows which are essential to mechanized farming.

Table 1. Key to management classes and yields produced on Quitman County soils with good management[1]

Soil type (or phase)		Management class	Yields per acre	
No.	Name		Cotton Lint (lbs.)	Corn (bu.)
	Soils derived from Mississippi River alluvium			
212	Dowling clay[2]	IV	Forest and wildlife land	
213	Dowling silty clay[2]	IV	Forest and wildlife land	
223	Panther silty clay	IV	175	15
224	Panther silty clay loam	IV	175	15
225	Panther silt loam	IV	250	20
235	Souva silt loam	I	425	40
*235	Souva silt loam (organic phase)	I	500	50
235 B^{-}	Souva silt loam (colluvial phase)	I	600	55
256	Oakwood loam	I	700	65
*256	Oakwood loam (organic phase)	I	725	75
322 A	Sharkey clay	II	425	20
322 A(A^{-})	Sharkey-Tunica-Panther complex[3]	VI	Forest and wildlife land	
322 A^{o}(A^{-})	Sharkey-Panther complex[3]	VI	Forest and wildlife land	
323 A	Sharkey silty clay	II	425	20
333 A	Tunica silty clay	II	550	25
344 A	Tunica-Dundee complex	II	625	35
424 A	Forestdale silty clay loam	III	425	20
424 A(A^{-})	Forestdale-Dundee-Sharkey-Panther complex[4]	VI	Forest and wildlife land	
425 A	Forestdale silt loam	III	475	25
434 A	Dundee silty clay loam	III	450	20
435 A	Dundee silt loam	I	600	55
*435 A	Dundee silt loam (organic phase)	I	700	65
436 A	Dundee loam	I	725	65
*436 A	Dundee loam (organic phase)	I	800	75
445 A	Dubbs silt loam	I	600	55
*445 A	Dubbs silt loam (organic phase)	I	750	65
446 A	Dubbs loam	I	725	65
*446 A	Dubbs loam (organic phase)	I	800	75
456 A	Bosket loam	I	750	65
*456 A	Bosket loam (organic phase)	I	825	75
457 A	Bosket sandy loam	I	750	65
*457 A	Bosket sandy loam (organic phase)	I	825	75
467 A	Clack sandy loam	V	300	20
468 A	Clack loamy sand	V	100	10
	Soils derived from mixed Mississippi River and Coldwater River alluvium			
534 A	Coldwater Commerce silty clay loam	III	425	25
534 A(A^{-})	Coldwater Commerce-Panther Complex[5]	VI	Forest and wildlife land	
535 A	Coldwater Commerce silt loam	I	700	60
612	Coldwater Dowling clay[2]	IV	Forest and wildlife land	
613	Coldwater Dowling silty clay[2]	IV	Forest and wildlife land	
623	Coldwater Panther silty clay	IV	150	15
624	Coldwater Panther silty clay loam	IV	150	15
625	Coldwater Panther silt loam	IV	225	20
635	Coldwater Souva silt loam	I	400	40
722 A	Coldwater Sharkey clay	II	425	20
722 A(A^{-})	Coldwater Sharkey-Tunica-Panther complex[6]	VI	Forest and wildlife land	
722 A^{o}(A^{-})	Coldwater Sharkey-Panther complex[6]	VI	Forest and wildlife land	
723 A	Coldwater Sharkey silty clay	II	425	20
724 A	(No name)	II	425	25
733 A	Coldwater Tunica silty clay	II	550	25
744 A	Coldwater Tunica-Dundee complex	II	600	30
745 A	(No name)	I	600	40

Table 1. Key to management classes and yields produced on Quitman County soils with good management[1] (Continued)

Soil type (or phase)		Manage- ment	Yields per acre	
No.	Name	class	Cotton Lint (lbs.)	Corn (bu.)
Soils derived from mixed Mississippi River and Coldwater River alluvium				
824 A	Coldwater Forestdale silty clay loam	III	400	20
824 A(A-)	Coldwater Forestdale-Dundee-Sharkey-Panther complex	VI	Forest and wildlife land	
825 A	Coldwater Forestdale silt loam	III	450	25
834 A	Coldwater Dundee silty clay loam	III	425	25
835 A	Coldwater Dundee silt loam	I	600	45
Soils derived from Little Tallahatchie and Yocona River alluvium				
T524 A	Tallahatchie Mhoon silty clay loam	III	420	20
T525 A	Tallahatchie Mhoon silt loam	III	450	30
T534 A	Tallahatchie Commerce silty clay loam	III	425	25
T534 A(A-)	Tallahatchie Commerce-Mhoon-Panther complex[7]	VI	Forest and wildlife land	
T535 A	Tallahatchie Commerce silt loam	I	650	50
T612	Tallahatchie Dowling clay	IV	Forest and wildlife land	
T613	Tallahatchie Dowling silty clay	IV	Forest and wildlife land	
T623	Tallahatchie Panther silty clay	IV	150	15
T624	Tallahatchie Panther silty clay loam	IV	150	15
T625	Tallahatchie Panther silt loam	IV	200	20
T824 A	Tallahatchie Forestdale silty clay loam	III	375	20
T824 A(A-)	Tallahatchie Forestdale-Dundee Panther complex[8]	VI	Forest and wildlife land	
T825 A	Tallahatchie Forestdale silt loam	III	425	25
T834 A	Tallahatchie Dundee silty clay loam	III	400	25
T835 A	Tallahatchie Dundee silt loam	I	600	45

[1] These yields are estimated for soils on A slopes that are protected from river overflow by a levee. Soils not protected by a levee will produce higher yields except when damaged by flood. As a rule, soils on B slopes produce slightly lower yields than those indicated in this table. See page 19 for management recommendations.

[2] Crops are often damaged by standing water. Where good surface drainage is possible, yields are about the same as for Panther silty clay.

[3] These areas are forested. See Sharkey, Tunica, and Panther yields.

[4] These areas are forested. See Forestdale, Dundee, Sharkey and Panther yields.

[5] These areas are forested. See Coldwater Commerce annd Coldwater Panther.

[6] These areas are forested. See Coldwater Sharkey, Coldwater Tunica, and Coldwater Panther.

[7] These areas are forested. See Tallahatchie Commerce and Tallahatchie Panther.

[8] These areas are forested. See Tallahatchie Dundee and Tallahatchie Panther.

Soils which have 4, 5, or 6 as the middle number (numbers indicate well, excellent, and excessive internal drainage) in their symbol generally require shallow V-shaped ditches in the associated depressions. Soils which have 1, 2, or 3 as the middle number (numbers indicate very poor, poor, and fair internal drainage) in the symbol generally require deeper ditches to provide adequate surface drainage. The spoil from all ditches should be spread back so that cultivation is not hindered.

In the eastern and southeastern part of the county where the soil number is preceded by the letter T, main or primary drainage is insufficient for the most efficient land use. After a system of primary drainage is established in this area, the local or secondary drainage can be handled as mentioned above.

Field Layouts and Row Direction

Where practicable, field boundaries should be placed on soil boundaries, then each field will contain only the soils that respond to the same management. Rotations, fertilizer treatments, and other management practices that are suitable for the entire field can then be planned.

As mentioned before, solid lines indicate an abrupt or sharp change between two soil types and, generally, field boundaries should be located along the solid line soil boundaries.

Dotted lines indicate a gradual change between two soil types and should not always be used as field boundaries. The only time a dotted line soil boundary should be used as a field boundary is when the two soil types separated by the dotted line soil boundary require a different type of soil management.

Where possible roads should serve as field boundaries and should be located on soil boundaries. Roads that cross soil boundaries and field boundaries rather than follow them tend to divide the fields in smaller units which are unsuited to mechanized farming. The boundaries of soils with C or D slopes as well as escarpments and bayou banks are ideal locations for roads.

Row direction in any field should be governed by the following factors: soil type, slope of the land, and the method of tillage. Rows on depressional soil (no letter following the soil number) should be run with or parallel to the ditch, generally found in the lowest part of the depression. Rows on soils with A^0 slope should run so as to provide the best possible run-off. On soil types where the middle soil type number is 1, 2, or 3 and the slope is A, each row should run so that it has slope enough to carry the water that falls on it to a ditch or outlet. On soil types where the middle soil type number is 4, 5, or 6, rows should be run on the contour (with the slope, not up and down) so that each row will hold the water that falls on it. The soils just mentioned have a sub-soil which allows water to move readily down through the soil. Water should not be allowed to run off these soils to more poorly drained soils. Rows on all B^-, B, C, and D slopes should be run on the contour in order to prevent harmful erosion and to conserve moisture.

Where mechanized methods of tillage are to be used, long rows are more efficient. By following the above suggestions on field layouts and row dircetion, longer rows and larger units can be had.

FERTILIZATION

Nitrogen and Organic Matter

Nitrogen has long been recognized as the main fertilizer element lacking in all Delta soils. Additions of nitrogen and organic matter to the soil increase the productivity for non-legume crops. Properly inoculated legume crops in the rotation provide the cheapest and best source of both nitrogen and organic matter. Bur clover and vetch are well adapted winter legumes for soil which have 5, 6, or 7 as the last number of their symbols. Vetch or winter peas are both adapted for growth on soils which have their last number as 2, 3, or 4. Where it is not practical to grow leguminous crops, commercial nitrogenous fertilizers must be used on all non-legume crops if maximum yields are to be obtained. Where a heavy leguminous crop has been turned under, additions of commercial nitrogenous fertilizer may cause excessive stalk growth on cotton and corn and lower yields may result. Depressional and first bottom soils which are overflowed every three or four years maintain a relatively high nitrogen level and do not require additions from commercial sources. In fields where small depressions are numerous more efficient use of nitrogenous fertilizer can be had by leaving the fertilizer off the rows that occur in the depression and use it to increase the amount applied to the ridges.

Recent experimentation with anhydrous ammonia shows that fertilization by this source has great promise, especially where mechanization is contemplated. Until further studies have been made definite information cannot be supplied.

Phosphorus and Potassium

Experimental work with phosphorus and potassium carrying fertilizer on "delta" soils has been somewhat limited, and it is impossible to make specific recommendations for their use. However, in Quitman County some phosphorus and potassium carrying fertilizers have been used and observations indicate that on certain soil types applications of phosphorus and potassium might be profitable. Laboratory tests indicate the approximate content of available phosphorus and potassium in a soil, but field tests are necessary before specific recommendations can be made.

Phosphorus deficiency is most likely to occur more on soils of the low terrace group formed from mixed Mississippi River and Coldwater River alluvium and from Little Tallahatchie and Yocona River alluvium, (Figure 1). The symbol numbers of these soils begin with 8 and T8. Observations have indicated that the Forestdale series, soil numbers 424 and 425, respond to applications of phosphorus. Soil acidity should be corrected by liming before phosphatic fertilizers are used.

Potassium deficiency is most likely to occur in sandy soils, especially in the group having their soil number begin with 8 and

T8. Soils that are deficient in potassium produce weak plants with slender stalks and stems. Rust or blight spots in cotton fields often indicate a deficiency of potassium in the soils.

Some soils have no obvious limiting physical characteristics such as poor drainage or steep slopes, yet do not produce average yields for that type when recommended practices are followed. In such cases, farmers may determine the cause of the low yields by fertilizing a small area of about six rows with several different fertilizers. These tests are most likely to be needed on low terrace soils (400, 800, and T800 groups) that are not organic phases. Yields from the fertilized plots should be carefully weighed, then compared with some adjoining plots of the same size that received no fertilizer. The County Agent should assist in selecting the fertilizers and arranging plots.

Table 2. Composition and availability of fertilizer materials

Fertilizer material	Nitrogen	Phosphorus (P_2O_5 units)	Potassium (K_2O units)	Availability
	Percent	Percent	Percent	
Nitrogen carriers				
Nitrate of soda	16	....	....	Quickly
Sulphate of ammonia	20	....	....	Quickly
Calcium cyanamid	22	....	....	Medium
Phosphorus carriers:				
Superphosphate	....	18 or 20	....	Quickly
Triple superphosphate	....	40 to 48	....	Quickly
Basic slag	....	8 to 12	....	Medium
Potassium carriers:				
Muriate of potash	....	....	50 or 60	Quickly
Kainit	....	....	20	Quickly
Manure salts	....	....	20	Quickly
Complete mixtures:				
6-8-6	6	8	6	Quickly
4-8-8	4	8	8	Quickly

PASTURE AND FORAGE CROPS

Experimental work with pastures on Quitman County soil types is very limited, however, the practices in pasture follow those found essential and efficient in other sections of the state. The soils that are best adapted to cotton and corn are generally the best adapted soils for pasture. The acreage of first class land on many farms is limited, so less productive soils are commonly used for pastures. Good management is essential for efficient use of any soil type for pasture.

A firm seedbed is essential to the establishment of a good pasture. It is recommended in Mississippi Experiment Station Bulletin 356 that "in cases where soil preparation is made, it should be done far enough in advance of planting for the seedbed to become firm. Where time is not allowed for firming, areas should be disked, harrowed, seeded, and cultipacked" (7).

Soils that have symbols ending in number 1, 2, or 3 may make good pasture with good management, and soils that have symbols ending in 5, 6, or 7 usually make excellent pastures under proper management. Soils that have 6 as the middle number are excessively sandy and require special management; see "Management by Soil Type," page 19. Acid soils should be limed before being seeded. Where clovers are to be grown the soil needs plenty of lime, phosphate and potash. Soil testing information available indicates that soils having their symbols beginning with 8 and T8 may require application of lime, phosphate and potash before clovers can be grown effectively. For season grazing and pasturing recommendations see Mississippi Agricultural Experiment Station Service Sheet No. 402 and Mississippi Agricultural Experiment Station Information Sheet No. 323.

FORESTRY

Approximately 30 percent of Quitman County[1] is growing some kind of timber at the present time. The total amount of forest land according to the Department of Forestry, State College, Mississippi, is 85,800 acres. Much of this forest land is subject to frequent overflows and is suited only for forest production.

Four fairly distinct types of bottom land hardwoods are found in Quitman County. They are as follows:

1. Swamp type. This type is made up primarily of cypress and tupelo gum. The land occupied by this forest type usually remains under water the year around. Soils numbered 213, 613, and T613 generally support this forest type.

2. Slough type, known as the Overcup Oak-Bitter Pecan type. This type is usually found on the lower elevations of the complexes numbered 322 $A(A^-)$ and 322 $A^o(A^-)$, 722 $A(A^-)$, 722 $A^o(A^-)$, and T824 $A(A^-)$, and on the depressional soils where water remains standing most of the year. Other species associated with this type include soft elm, maple, green ash, hackberry, persimmon, sweet gum, and willow oak.

3. Cherry bark and cow oak-hickory type. This is a very mixed and variable type, but is usually identified by having one or all of the above species together with other species such as post oak, black gum and winged elm. The higher elevation of the soil complex numbers, 424 $A(A^-)$, 824 $A(A^-)$, and T824 $A(A^-)$, support this type.

4. Water oak-gum type. This type is always characterized by either the gum or the oaks in varying portions. The higher elevation of the soil complexes number 322 $A(A^-)$, 322 $A^o(A^-)$, 722 $A(A^-)$, and 722 $A^o(A^-)$ support this type.

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[1] Information on Forestry furnished by Monty Payne, Head, Department of Forestry, State College, Mississippi.

In Quitman County there are large wooded areas (shown as wooded soil complexes on the soil map) where primary drainage is inadequate. Where this is the case the potential agricultural value of the land can be determined by examining the soil map and determining whether or not the predominating soil types found in this area are desirable. If the soil types occurring in this area will not justify the expenses of providing drainage, it is recommended that this land stay in timber and proper timber management practices be applied.

With the present timber prices being at an all time high, and with new developments in the chemurgic field, the prospects for future markets and better utilization of forest products is very good.

Less than 5 percent of the land owners in Quitman County are today managing their timber as a crop. It is hoped that as more information on management of bottomland hardwoods is made available to the landowners of the county by the Delta Branch Experiment Station, that farmers will not only recognize timber as a crop but will begin to manage it as one.

Cropping Systems Recommended For Use In Quitman County

For convenience in determining adapted cropping systems for the soils in Quitman County, the soil types are grouped into five management classes on the basis of fertility, drainage, adapted crops, and workability. The class of each soil type is listed in table 1 on page 12.

The cropping systems for all classes are listed in table 3, page 19. A complete discussion of the management for each soil type is given under "Management by Soil Type," beginning on page 19.

All cropping systems are planned to maintain the most efficient production of adapted crops on a permanent basis. Cotton is considered the principal cash crop and is given the most favorable position in rotations for soils where it is adapted. Supplemental rotations are also given for each class in which grain or hay production, or both, are given consideration.

Table 3. Cropping systems recommended for Quitman County soils.

Management class	Soil Type No.	Year	Rotations		
			Cotton (as often as possible)	Cotton and grain	Hay or hay and grain
I	235 745 256 535 435 835 436 T535 445 T835 456 457 635	1	Continuous Cotton (plant vetch each fall)	Cotton (plant vetch or bur clover in fall)	Fallow (plant alfalfa in the fall)
		2		Corn (interplant with soybeans)	Alfalfa
		3		Cotton (plant vetch in fall)	Alfalfa
		4		Corn (interplant with soybeans)	Alfalfa
		5			Alfalfa
II	322 323 333 344 722 723 724 733 744	1	Cotton (plant vetch in the fall)	Soybeans (plant oats in the fall)	Soybeans (plant oats in the fall)
		2	Vetch seed (plant cow peas or soybeans in June	Oats (plant soybeans, sweet clover, or lespedeza in the spring.)	Oats (plant soybeans in the spring)
		3	Cotton	Cotton	Oats (plant soybeans in the spring)
		4	Cotton	Cotton	Oats (plant soybeans in the spring)
		5			Oats (plant soybeans in the spring)
		6			
III	424 T834 425 434 534 824 825 834 T524 T534 T525 T824 T825	1	Soybeans (turned under in the fall)	Soybeans (plant oats in the fall)	Soybeans (plant oats in the fall)
		2	Cotton (plant vetch in the fall)	Oats (Soybeans, lespedeza, or sweet clover in the spring)	Oats (plant soybeans in the spring)
		3 2	Vetch seed (plant cowpeas, soybeans in June)	Cotton	Oats (plant soybeans in the spring)
		4	Cotton	Cotton	Oats (plant soybeans in the spring)
		5	Cotton	Cotton	Oats (plant soybeans in the spring)
IV	212 625 223 T612 224 T623 225 T624 612 T625 623 624	1			Soybeans (for hay)
		2 1	Cotton not recommended	Cotton not recommended	Soybeans (turned under and followed by oats)
		3			Oats (plant soybeans or lespedeza in spring)
V	467 468		Best adapted to drouth-resistant hay and pasture crops, and early crops, (sweet corn)		
VI	213 322 $A^o(A^-)$ 322 $A(A^-)$ 424 $A(A^-)$ 534 $A(A^-)$ 613 722 $A^o(A^-)$ 722 $A(A^-)$ 824 $A(A^-)$ T534 $A(A^-)$ T613 T824 $A(A^-)$			Forest and wildlife land.	

MANAGEMENT BY SOIL TYPE

This discussion covers drainage, crop adaptation, rotation, and fertilizer recommendations for each soil type. Fertilizer recommendations are omitted where no experimental work or apparent deficiency symptoms indicate a need for commercial fertilizers. Rotations and management recommendations are based on experiment station results, practices followed by the best farmers and practices that should prove satisfactory under Quitman County conditions. Where there is a possibility that a crop practice may not be adapted, a notation advises that it be tried on a small scale at first. Cotton is assumed to be the principal cash crop on most all farms. The principles discussed under "General Soil Management, (page 11), must be followed if best yields are to be obtained from any soil.

MISSISSIPPI RIVER ALLUVIUM

A. DEPRESSIONAL SOILS. GROUP 200 (derived from Mississipp River alluvium).

Soil Type 212. Dowling clay.

This is a very poorly drained fertile clay soil that is difficult to manage and is limited in productivity by its fine texture (clay) and its low position. Deep ditches must be provided before cultivation is possible.

This soil is adapted to soybeans, sagrain, sorghum, and sudan grass. Corn makes fair yields when the season is favorable, but may fail completely when moisture conditions are not satisfactory. A 100 to 200 pound application of a nitrogenous fertilizer should be applied when corn is grown, if soil has been in cultivation many years.

For row crops, this soil should be bedded with three furrows early in the fall and left until spring.

Soil type 213. Dowling silty clay

This is a very poorly drained soil that remains under water most of the year and normally supports cypress or tupelo gum tree growth. Without artificial drainage this soil is of very little agricultural value. When drained it responds to the same management as 212, Dowling clay, (see page 20).

Soil type 223. Panther silty clay

This is a poorly drained silty clay soil that responds to the same management as 212, Dowling clay, (see page 20). It differs from 212, Dowling clay in that shallow ditches often provide adequate drainage. Cotton and corn occasionally make fair yields.

Soil type 224. Panther silty clay loam

This is a poorly drained soil with a somewhat coarser texture (less clay) on the surface than 223, Panther silty clay. This soil responds to the same management as 212, Dowling clay (see page

20), except that shallow ditches often provide adequate drainage. Cotton and corn occasionally make fair yields.

Soil type 225. Panther silt loam

This is a poorly drained soil with a silt loam surface (not as much clay as silty clay loam), consequently it is easier to till. This soil responds to the same management as 212, Dowling clay (see page 20), except that shallow ditches often provide adequate drainage and it is better adapted for cultivated crops. Cotton and corn often make fair yields.

Soil type 235. Souva slit loam

This is a fairly well drained soil with a silt loam surface. This soil can ordinarily be used to best advantage when it receives treatment similar to that of the bordering soils. Shallow ditches are needed to obtain good drainage except when it is on a B^- slope. It is not necessary to follow rotations on this soil, and application of commercial fertilizers should be light. Rows should usually be arranged to run in the same general direction as the strips of soil. This permits these areas to be planted and cultivated when they have proper moisture content without having to delay or disrupt cultivation of the remainder of the field. An arrangement of rows such as this prevents a concentration of drainage water in the depression where it is not needed and helps avoid poor crop stands.

Soil type *235. Souva silt loam (organic phase)

This is a fairly well drained dark colored more fertile soil than normal Souva silt loam, and responds to the same treatments.

Soil type 256. Oakwood loam.

This is an excellently drained sandy soil that responds to the same management as 235, Souva silt loam and *235, Souva silt loam (organic phase) (see above).

B. LOW BOTTOM SOILS. GROUP 300 (derived from Mississippi River alluvium).

Soil type 322. Sharkey clay

This is a poorly drained soil limited in productivity by its "heaviness," (high clay content). Frequent ditches are necessary to provide satisfactory drainage for this soil where it has either A or A^0 slopes.

Soybeans, oats, cotton, vetch, and Austrian winter peas are adapted crops for this soil. Corn should not be grown except on "new ground" or areas where heavy crops of legumes have been plowed under. Alfalfa and sweet clover are adapted where this soil is neutral or alkaline. Alfalfa should not be planted on poorly drained flat areas unless adequate drainage ditches are provided.

Experimental work at the Delta Experiment Station (4) indicates that 40 to 50 pounds of commercial nitrogen was used profitably under cotton on a "buckshot soil" similar to 322, Sharkey clay. Where leguminous crops have been turned under commercial nitrogen application should be light. Ten-year average results at the Delta Station show that a crop of hairy vetch equals 55.4 pounds of commercial nitrogen, and increased cotton more than did 30 pounds of nitrogen every year except one (5).

Recent data (8) show that application of more than 30 pounds of nitrogen under oats causes considerable lodging which results in lower yields. Oats should be fertilized with 150 to 200 pounds of nitrogenous fertilizer unless a leguminous crop has been turned under the preceding year.

Suggested cropping systems are :

Year	Rotation No. 1	Rotation No. 2	Rotation No. 3
1	Cotton (plant vetch in the fall)	Soybeans (plant oats in the fall)	Soybeans (plant oats in the fall)
2	Vetch seed (plant Cowpeas or soybeans in June)	Oats (plant soybeans or lespedeza in spring)	Oats (plant soybeans in spring)
3	Cotton	Cotton	Oats (plant soybeans in spring)
4	Cotton	Cotton	Oats (plant soybeans in spring)

These rotations are arranged to provide sufficient green manure crops to maintain a satisfactory content of organic matter and nitrogen in the soil. The presence of organic matter in large quantities makes cultivation of this soil easier and will raise the productivity level.

In the second year of rotation No. 1, the vetch stubble and straw should be turned under as soon as the vetch seed have been harvested, and cowpeas or soybeans should be planted. In the fall, the cowpeas or soybeans should be turned under before frost and the land bedded.

In rotations No. 2 and 3 soybeans should be turned under in late July or early August and the oats planted in October. In early spring, soybeans or lespedeza should be drilled in the oats and then turned under in the fall when maximum growth has been reached. It may be desirable in some cases to harvest the soybean or lespedeza seed with a combine and then plow under the stubble and straw.

Where soil tests (see County Agent) show the soil to be neutral or alkaline, alfalfa can be substituted in rotation No. 3 the second year. After the oats have been harvested in early summer the soil should be turned as deeply as practical with a pan or flat bottom breaking plow and fallowed until early fall. Before alfalfa is planted the field should have surface drains plowed out with a grader plow or single disk section. These drains should be used on most A slopes and on all A^{o} slopes and should be placed every 20 or 30 feet apart for satisfactory surface drainage.

After 3 or 4 years when the alfalfa stand has become thin, the field should be plowed in August and prepared for winter oats. Cotton should be grown for two or three years after alfalfa has been turned under, then either rotation No. 1 or No. 3 should be used before reseeding to alfalfa.

Soil type 322 $A(A^{-})$. Sharkey-Tunica-Panther complex

This complex of soils contains gently undulating, forested ridges and poorly drained depressions. The predominating soils are 322, Sharkey clay, with 212, Dowling clay; 213, Dowling silty clay; and 223. Panther silty clay. Small areas of 424, Forestdale silty clay loam and 333, Tunica silty clay are also included. After these areas are cleared, corn or cotton can be grown continuously until yields start dropping. Then the soils will respond to the same management as 322, Sharkey clay (see page 21), and 212 Dowling clay (see page 20).

Soil type 322 $A^{o}(A^{-})$. Sharkey-Panther complex

This complex of soils is similar to 322 $A(A^{-})$, Sharkey-Tunica-Panther complex (see above), except that the topography is nearly flat and there is no 333, Tunica silty clay, in the area. Extensive drainage systems are usually necessary before these areas can be cultivated successfully. Unless sufficient drainage is provided, it is recommended that this complex stay in timber. When properly drained, these soils will respond to the same management as 322, Sharkey clay (see page 21), and 212, Dowling clay (see page 20).

Soil type 323. Sharkey silty clay

This is a poorly drained "buckshot" soil, having less clay in the surface than 322 Sharkey clay. This soil responds to the same management as 322, Sharkey clay (see page 21).

Soil type 333. Tunica silty clay

This is a fairly well drained "buckshot" soil that responds to the same management as 322, Sharkey clay (see page 21) except that little artificial drainage is necessary. Most areas can be adequately drained by a few small ditches.

Soil type 334. Low Bottom escarpment

The soil type in this escarpment is similar to 322, Sharkey clay, except that it occurs on steep slopes and requires no artificial drainage. Where possible this soil should be put into a permanent pasture. If, however, cultivated crops are grown, rows should be run on the contour rather than up and down the slope.

Soil type 344. Tunica-Dundee complex

The soil types found in this complex respond to the same management as 322, Sharkey clay, except that little artificial drainage is necessary. Some of these areas are sandy and suitable for corn and truck crop production. In this case management suggestions made for 424, Forestdale silty clay loam (see page 24) are applicable.

C. LOW TERRACE SOILS, GROUP 400 (derived from Mississippi River alluvium).

Soil type 424. Forestdale silty clay loam

This is a poorly drained soil with a silty clay loam surface that is low in fertility. Careful management is necessary to produce profitable returns. Frequent small drains leading to fairly deep outlet ditches are necessary to provide adequate drainage where this soil has an A slope. No artificial drainage is necesary where this soil has a B slope.

Soy beans, oats, cotton, Austrian winter peas and vetch are fairly well adapted to this soil. Corn should not be grown except on "new ground", or areas where large quantities of organic matter have been plowed under.

Cotton and oats should be fertilized with 150 to 200 pounds of nitrogenous fertilizer unless a good crop of green manure has been turned under, as shown in the suggested cropping systems as in rotation No. 2 in the fourth year.

Suggested cropping systems are:

Year	Rotation No. 1	Rotation No. 2	Rotation No. 3
1	Soybeans (turned under in fall)	Soybeans (plant oats in fall)	Soybeans (plant oats in fall)
2	Cotton (plant vetch in fall)	Oats (plant lespedeza or soybeans in spring)	Oats (plant soybeans in spring)
3	Vetch seed (plant soybeans in June)	Cotton	Oats (plant soybeans in spring)
4	Cotton	Cotton	Oats (plant soybeans in spring)
5	Cotton	Cotton	Oats (plant soybeans in fall)

The above rotations are similar to those recommended for soil type 322 A, Sharkey clay (see page 21), and the individual crops should be managed in the same way.

Alfalfa is not too well adapted to this soil but can be grown. Two tons of ground limestone per acre should be applied. Areas where water table remains high and where surface drainage is poor should not be seeded to alfalfa. If alfalfa is grown, a crop of soybeans should be turned under in July or early August and the soil fallowed until September when alfalfa is planted.

Soil type 424 A(A$^-$). Forestdale-Dundee-Sharkey-Panther complex

This complex of soils contains gently undulating, forested ridges and poorly drained depressions. The predominating soil types are 424, Forestdale silty clay loam; 434, Dundee silty clay loam; 435, Dundee silt loam; 322, Sharkey clay; and 223, Panther silty clay. After these areas have been cleared, these soils can be recognized and managed according to recommendations mentioned for these soil types, (see "Management by Soil Type," pages 19 to 26).

Soil type 425. Forestdale silt loam

This is a poorly drained soil with a silt loam surface. This soil works easily and is responsive to good management. Small drains leading to shallow outlet ditches should be used to drain this soil where it has an A slope.

All local crops are fairly well adapted to this soil after adequate surface drainage is provided. This is an acid soil and lime should be applied before legumes are grown. If alfalfa or sweet clover is grown, 2 tons of lime per acre should be applied. One ton of lime per acre should be applied where soybeans and winter cover crops are grown. Cotton and corn on this soil may give profitable response to applications of a complete fertilizer. A small area should be selected (see County Agent) for experimental work in order that effects from various fertilizer treatments can be determined. Cotton and corn should be fertilized with 200 pounds of a nitrogenous fertilizer unless a good legume crop has been plowed under, as shown in the suggested cropping systems as in rotation No. 2. in the fourth year.

Suggested cropping systems are:

Year	Rotation No. 1	Rotation No. 2	Rotation No. 3
1	Soybeans (plant vetch or bur clover in fall)	Cotton (vetch or bur clover in fall)	Soybeans (plant oats in fall)
2	Vetch or clover seed (plant corn in June)	Clover seed (followed by corn)	Oats (plant soybeans in spring)
3	Cotton	Cotton	Oats (plant soybeans in spring)
4	Cotton	Cotton	Oats (plant soybeans in spring)
5	Cotton	Soybeans	Oats (plant soybeans in fall)
6		Oats (soybeans or lespedeza)	Corn

In rotation No. 1, seed may be harvested from the soybeans before the straw and stubble are plowed under. However, best results will be obtained from the succeeding crops if the soybeans are plowed under while green. Following winter cover crops. corn should not be planted until the cover crop has matured enough seed to reseed itself the following fall, or in the case of bur clover, it may be desirable to harvest a seed crop. Winter cover crops should be planted on this soil when possible. If winter cover crops are grown the land should be disked thoroughly and bedded at least two weeks before cotton is planted. Where winter cover crops are not grown, this soil should be flat broken and bedded, or disked and bedded in late fall or early winter.

Good bur clover stands may be difficult to establish on this soil. Application of borax (15 pounds per acre) may correct this situation. Yellowing of the leaves and eventual dying of the plants may be indications of boron deficiency.

Soil type 434. Dundee silty clay loam

This is a fairly well drained soil with a silty clay loam surface. This soil responds to the same management as 424, Forestdale silty clay loam (see page 24), except that less artificial drainage is necessary.

Soil type 435. Dundee silt loam[1]

This is a fairly well drained soil with an easily tilled silt loam surface. This soil responds to the same management as 425, Forestdale silt loam, (see page 25), except that less artificial drainage is necessary. The organic phase of this soil, *435, is slightly more productive than the regular 435, Dundee silt loam and responds to the same management as 436, Dundee loam (see page 26).

Soil type 436. Dundee loam

This is a fairly well drained sandy fertile soil that is esaily managed. A few small V-type ditches provide adequate surface drainage.

This soil is well adapted to all local crops but is generally used for cotton and corn production. High yields of cotton and corn can be maintained if leguminous winter cover crops are grown or sufficient commercial fertilizer is added. Bur clover and vetch are excellent winter crops for this soil. From 150 to 200 pounds of a nitrogenous fertilizer should be applied to cotton and corn if a leguminous cover crop is not grown, as shown in the suggested cropping systems and in rotation No. 2 in the fourth year. Recent observations have indicated that in some cases it has been profitable in corn production to double the stand and double the amount of nitrogenous fertilizer.

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[1] The presence of the organic phase symbol (*) in front of the soil number denotes higher fertility than is usual for this soil type.

Suggested cropping systems are:

Year	Rotation No. 1	Rotation No. 2	Rotation No. 3
1	Continuous cotton (plant vetch each fall)	Cotton (plant vetch or bur clover in fall)	Fallow (plant alfalfa in fall)
2		Corn (interplant with soybeans)	Alfalfa
3		Cotton (plant vetch in fall)	Alfalfa
4		Corn (interplant with soybeans)	Alfalfa

This soil is very well adapted for corn production, therefore rotation No. 2 is highly recommended.

A substitute rotation for No. 2 rotation is to plant cotton the first year with bur clover planted in the fall. Harvest bur clover seed the second year and plant corn behind the bur clover in June. Then follow with two years of cotton.

Before alfalfa is seeded one ton of ground limestone per acre should be applied. Alfalfa should not be planted where a thick stand of bur clover is likely to volunteer. Rotation No. 1 or No. 2 should follow rotation No. 3. If alfalfa begins to turn yellow, applications of boron may prove profitable.

Soil type 445. Dubbs silt loam[1]

This is a moderately well drained moderately fertile soil with an easily tilled silt loam surface. This soil is adapted to all local crops and responds to the same management as 435, Dundee silt loam. On some areas where the best management has not been practiced and fertility is low, rotations suggested for soil type 425, Forestdale silt loam (see page 25) should be used. Two tons of ground limestone should be applied per acre where alfalfa is to be grown. If soybeans and winter cover crops do not grow well, one ton of lime should be applied per acre.

Soil type 446. Dubbs loam[1]

This is moderately well drained fertile soil with an easily tilled sandy surface. It is adapted to all crops and responds to the same management as 436 A, Dundee loam. A ton of ground limestone per acre should be applied for alfalfa unless the soil is an organic phase.

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[1] The presence of the organic symbol (*) in front of this soil number denotes higher fertility than is usual for this soil type.

Soil type 447. Low terrace escarpment (sand and clay beds)

This soil occurs on slopes similar to those of 334, low bottom escarpment (see page 24), and responds to the same management. Some areas make excellent bur clover seed patches. This soil on a C slope often produces good yields of all crops and is excellent for pasture.

Soil type 456. Bosket loam[1]

This is a well drained fertile sandy soil easily managed that responds to the same management as 436, Dundee loam (see page 26). No artificial drainage is necessary. This is one of the most productive soils in the county.

Soil type 457. Bosket sandy loam[1]

This is a well drained fertile soil somewhat sandier than 456, Bosket loam that responds to the same management as 436, Dundee loam, (see page 26). No artificial drainage is necessary.

Soil type 467. Clack sandy loam

This is an excessively drained somewhat droughty sandy soil that requires no artificial drainage. This soil is difficult to manage because of its "droughty" nature. Where cotton and corn are grown, yields are very uncertain. The soil, where practical, should be planted to some early maturing crops such as sweet corn. Drouth resistant hay or pasture crops can be grown with profitable results. Sudan grass can be grown for early pasture. Soybeans may make fair yields of seed during favorable seasons. Black locust seedlings for fence post production should be grown on a small trial area. A 1000-pound application of limestone every five years may increase growth of legumes.

Soil type 468. Clack loamy sand

This is an excessively drained extremely "draughty" sandy soil and no row crops should be grown. It is unsuitable for anything but early pasture, hay and timber growth.

MIXED MISSISSIPPI AND COLDWATER RIVER ALLUVIUM

D. FIRST BOTTOM SOILS, GROUP 500 (derived from mixed Mississippi River and Coldwater River alluvium)

Soil type 534. Coldwater Commerce silty clay loam

This is a fairly well drained moderately fertile soil with a silty clay loam surface. Unless this soil is protected by levees or diversion channels it over flows frequently.

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[1] The presence of the organic symbol (*) in fron of this soil number denotes higher fertility than is usual for this soil type.

Where protected from overflow the soil is adapted to all local crops. Cotton should not be grown if there is danger of overflow. Corn, soybeans, and sorghum make good growth without fertilizer so long as overflows are frequent enough to maintain soil fertility. Where this soil is protected by a levee, it will respond to the same management as soil type 424, Forestdale silty clay loam (see page 24).

Soil type 534 A(A-). Coldwater Commerce Panther complex

This complex of soils contains undulating forested ridges occurring along the banks of Coldwater River and are subject to frequent overflow. The predominating soil types in this complex are 534, Coldwater Commerce silty clay loam; 535, Coldwater Commerce silt loam; and 623 Coldwater Panther silty clay. Where these areas are cleared and protected from overflow, the soils respond to the same type of management as specified for soils 534 and 535, (see page 28 and 29).

Soil type 535. Coldwater Commerce silt loam

This is a fairly well drained moderately fertile soil with an easily tilled silt loam surface. Many areas of this soil overflow frequently, and should be used only for corn, soybeans, and sorghums. Artificial drainage of this soil is seldom necessary.

Where protected from overflow, this soil is well adapted for the growing of all local crops. It is an excellent soil for truck crops, cotton and corn production. It will respond to the same management as 436, Dundee loam (see page 26), except that phosphorus and potassium fertilizers may be needed to maintain maximum production permanently and little artificial drainage is necessary.

E. DEPRESSIONAL SOILS, GROUP 600 (derived from mixed Mississippi River and Coldwater River alluvium)

Soil type 612. Coldwater Dowling clay

This is a very poorly drained clay soil that responds to the same management as 212, Dowling clay (see page 20).

Soil type 613. Coldwater Dowling silty clay

This is a very poorly drained silty clay soil that usually stays under water (swamp) and requires extensive drainage systems before it can be cultivated. This soil responds to the same management as 212, Dowling clay (see page 20).

Soil type 623. Coldwater Panther silty clay

This is a poorly drained silty clay soil that responds to the same management as 212, Dowling clay (see page 20), except that shallow ditches often provide adequate drainage. Cotton and corn occasionally make fair yields.

Soil type 624. Coldwater Panther silty clay loam

This is a poorly drained soil with a silty clay loam surface. This soil responds to the same management as 212, Dowling clay (see page 20), except that shallow ditches often provide adequate drainage. Cotton and corn often make fair yields.

Soil type 625. Coldwater Panther silt loam

This is a poorly drained soil with an easily tilled silt loam surface. This soil responds to the same management as 212, Dowling clay (see page 20), except that shallow ditches often provide adequate drainage and it is better adapted for cultivated crops. Cotton and corn often make fair yields.

Soil type 635. Coldwater Souva silt loam

This is a fairly well drained moderately fertile soil with an easily tilled silt loam surface. This soil responds to the same management as 235, Souva silt loam, (see page 21).

F. LOW BOTTOM SOILS, GROUP 700 (derived from mixed Mississippi River and Coldwater River alluvium)

Members of this group of soils are inundated by flood water more frequently than the corresponding members of the 300 group (see page 21).

Soil type 722. Coldwater Sharkey clay

This is a poorly drained clay soil (buckshot), that responds to the same management as 322, Sharkey clay (see page 21).

Soil type 722 A(A-). Coldwater Sharkey-Tunica-Panther complex

The soil types found in this complex are similar to those found in 322 A(A-), Sharkey-Tunica-Panther complex (see page 23), and respond to the same management as 322, Sharkey clay (see page 21). Where drainage is not provided this complex should remain in timber and proper timber management practices used (see page 17).

Soil type 722 $A^{\circ}(A^{-})$. Coldwater Sharkey-Panther complex

The soil types found in this complex are similar to those found in 322 $A^{\circ}(A^{-})$, Sharkey-Panther complex, (see page 23), and respond to the same management as 322, Sharkey clay (see page 21). Where drainage is not provided this complex should remain in timber and proper timber management practices used. (see page 17).

Soil type 723. Coldwater Sharkey silty clay

This is a poorly drained silty clay soil ("light buckshot") that responds to the same management as 322, Sharkey clay (see page 21).

Soil type 724. (No name)

This is a poorly drained "sandy buckshot" more easily tilled than 722, Sharkey clay. Fair yields of corn may be obtained on the sandier areas. This soil responds to the same management as 322, Sharkey clay (see page 21).

Soil type 733. Coldwater Tunica silty clay

This is a fairly well drained "buckshot" soil that responds to the same management as 322, Sharkey clay (see page 21).

Soil type 734. Low Bottom escarpment

The soil type in this escarpment is similar to 322, Sharkey clay (see page 21), and responds to the same management as 334, Low Bottom escarpment (see page 24).

Soil type 744. Coldwater Tunica-Dundee complex

The soil types found in this complex respond to the same management as 344, Tunica-Dundee complex (see page 24), or 322, Sharkey clay (see page 21).

Soil type 745. (No name)

This is a shallow soil with a 10-inch to 24-inch layer of soil similar to 835, Coldwater Dundee silt loam (see page 35), over heavy clay. This soil responds to the same management as 436, Dundee loam (see page 26), except that some areas are not well adapted to truck crop production if the underlying clay is close to the surface. Rows on sloping areas should be run on the contour so that erosion will not remove the surface soil and expose the underlying clay.

G. LOW TERRACE SOILS, GROUP 800 (derived from mixed Mississippi River and Coldwater River alluvium)

Soil type 824. Coldwater Forestdale silty clay loam

This is a poorly drained soil with a silty clay loam surface and it responds to the same management as 424, Forestdale silty clay loam (see page 24). Alfalfa is not recommended for growth on this soil. Some areas of this soil are inundated by flood water occasionally.

Soil type 824 A(A-). Coldwater Forestdale-Dundee-Sharkey-Panther complex

This complex of soils contains gently undulating forested ridges and poorly drained depressions. The predominating soil types are 824, Coldwater Forestdale silty clay loam; 834, Coldwater Dundee silty clay loam; 722, Coldwater Sharkey clay; and 623, Coldwater Panther silty clay. After these areas have been cleared, these soils can be recognized and managed according to the recommendations for these soil types, (see "Management by Soil Type". page 19 to 26).

Soil type 825. Coldwater Forestdale silt loam

This is a poorly drained soil with an easily tilled silt loam surface and it responds to the same management as 425, Forestdale silt loam (see page 25). An application of a complete fertilizer (nitrogen, phosphorous and potassium) may give profitable results when applied to corn or cotton. Experimental areas should be fertilized with each fertilizer (see County Agent). This soil is usually strongly acid and therefore lime should be applied before legume crops are grown. Application of borax may improve stands of bur clover.

Soil type 834. Coldwater Dundee silty clay loam

This is a fairly well drained soil with a silty clay loam surface that responds to the same management as 434, Dundee silty clay (see page 26).

Soil type 835. Coldwater Dundee silt loam

This is a fairly well drained soil with an easily tilled silt loam surface and it responds to the same management as 425, Forestdale silt loam (see page 25), except that less artificial drainage is necessary. This soil is adapted to truck crop production.

LITTLE TALLAHATCHIE AND YOCONA RIVER ALLUVIUM

H. FIRST BOTTOM SOILS, GROUP T500 (derived from Little Tallahatchie and Yocona River alluvium)

A better system of main or primary drainage is necessary before most of the soils formed from Little Tallahatchie and Yocona River alluvium can be utilized for cultivated crops. Under the present system of main drainage the best management practices cannot be followed. Approximately 30 percent of these soils are in timber. Where practical the lower areas should be left in timber and good timber management practices put into effect (see page 17).

Where these soils have been put into cultivation and adequate drainage provided general management practices (see page 11) apply.

All of these soils (denoted by the letter T before the soil type number) are strongly acid and should have applications of lime before legumes are grown (see County Agent). The limited amount of experimental data on these soils indicate that applications of a complete fertilizer (nitrogen, phosphorus, and potassium) may be profitable under cotton and corn.

The following recommendations are made on the basis that adequate main drainage has been provided.

Soil type T524. Tallahatchie Mhoon silty clay loam

This is a poorly drained "fresh" soil with a silty clay loam surface, and it responds to the same management as 424, Forestdale silty clay loam (see page 24), except that more artificial drainage is necessary and a complete fertilizer may be needed.

Soil type T525. Tallahatchie Mhoon silt loam

This is a poorly drained "fresh" soil with an easily tilled silt loam surface, and it responds to the same management as 425, Forestdale silt loam (see page 25), except that more artificial drainage is necessary and a complete fertilizer may be needed.

Soil type T534. Tallahatchie Commerce silty clay loam

This is a fairly well drained "fresh" soil with a silty clay loam surface and it responds to the same management as 424, Forestdale silty clay loam (see page 24).

Soil type T534 A(A-). Tallahatchie Commerce-Mhoon-Panther complex

This complex of soils contains gently undulating forested areas. The predominating soil types are T534, Tallahatchie Commerce silty clay loam; T524, Tallahatchie Mhoon silty clay loam; and T623, Tallahatchie Panther silty clay loam. When cleared and protected from overflow, the soils respond to the same management as mentioned in "Management by Soil Type" (see pages 19 to 26).

Soil type T535. Tallahatchie Commerce silt loam

This is a fairly well drained moderately productive soil with an easily tilled silt loam surface.. Small V-type ditches in low places provide adequate surface drainage. This soil is excellent for truck crops, cotton, corn, and pasture. It will respond to the same management as 436, Dundee loam, (see page 26), except that a complete fertilizer may be needed. Alfalfa is not recommended for this soil In rotation No. 3 oats and soybeans should be substituted for alfalfa.

I. DEPRESSIONAL SOILS, GROUP T600 (derived from Little Tallahatchie and Yocona River alluvium)

Soil type T612. Tallahatchie Dowling clay

This is a very poorly drained low wet soil that responds to the same management as 212, Dowling clay, (see page 20).

Soil type T613. Tallahatchie Dowling silty clay

This is a very poorly drained soil that remains under water most of the year. When drained by deep ditches, it responds to the same management as 212, Dowling clay, (see page 20).

Soil type T623. Tallahatchie Panther silty clay

This is a poorly drained wet soil that responds to the same management as 212, Dowling clay (see page 20), except that shallow ditches often provide adequate drainage.

Soil type T624. Tallahatchie Panther silty clay loam

This is a poorly drained soil which occupies a low position and responds to the same management as 212, Dowling clay (see page 20), except that shallow ditches often provide adequate drainage.

Soil type T625. Tallahatchie Panther silt loam

This is a poorly drained soil that occupies a low position and has an easily tilled silt loam suface. This soil responds to the same management as 212, Dowling clay (see page 20), except that shallow ditches often provide adequate drainage and it is better adapted for cultivated crops. Cotton and corn often make fair yields.

J. LOW TERRACE SOILS, GROUP T800 (derived from Little Tallahatchie and Yocona River alluvium)

Soil type T824. Tallahatchie Forestdale silty clay loam

This is a poorly drained strongly acid soil with a silty clay loam surface. It responds to the same management as 424, Forestdale silty clay loam (see page 24), except that applications of a complete fertilizer may be needed. Also lime should be applied before legumes are grown.

Soil type T824. A(A-). Tallahatchie Forestdale-Dundee-Panther complex

This complex of soils contain flat to gently undulating forested areas. The predominating soil types are T824, Tallahatchie Forestdale silty clay loam; T834, Tallahatchie Commerce silty clay loam; and T623, Tallahatchie Panther silty clay loam. It is recommended that these areas stay in timber unless better primary drainage is provided in the southeastern portion of the county. If these areas are cleared and properly drained, the same management recommendations mentioned in "Management by Soil Type" will apply, (see pages 19 to 26).

Soil type T825. Tallahatchie Forestdale silt loam

This is a poorly drained strongly acid soil with an easily tilled silt loam surface. This soil responds to the same management as 425, Forestdale silt loam (see page 25), except that applications of a complete fertilizer may be needed. Also lime should be applied before legumes are grown.

Soil type T834. Tallahatchie Dundee silty clay loam

This is a fairly well drained strongly acid soil with a silty clay loam surface. This soil responds to the same management as 434, Dundee silty clay loam (see page 26), except that applications of a complete fertilizer may be needed. Also lime should be applied before legumes are grown.

Soil type T835. Tallahatchie Dundee silt loam

This is a fairly well drained strongly acid soil with an easily tilled silt loam surface. This soil responds to the same management as 425, Forestdale silt loam (see page 25), except that less artificial drainage is necessary, applications of a complete fertilizer may be needed, and lime should be applied before legumes are grown. This soil is also adapted to truck crop production.

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BULLETIN 448 JUNE, 1947

MISS. EXPERIMENT STATION LIBRARY
STATE COLLEGE

AMMONIA
AS A SOURCE OF NITROGEN

Applying anhydrous ammonia before planting cotton.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
RUSSELL COLEMAN, Acting Director
STATE COLLEGE MISSISSIPPI

Anhydrous ammonia is the cheapest source of nitrogen available. It may be handled in the tanks used for propane, used in flame cultivation.

The pressure which anhydrous ammonia exerts varies with the temperature and may reach 250 pounds per square inch on hot summer days. This high pressure is not dangerous provided the equipment contains the necessary safety devices.

Anhydrous ammonia may be diluted with water to form a 30 percent ammonia solution which exerts little or no pressure except with high summer temperatures, and then only a low pressure is obtained. Anhydrous ammonia and solutions of ammonia have equal value for crop production.

In experimental work anhydrous ammonia and solutions of ammonia (aqua ammonia) have been found to have crop-producing value equal to or superior to ammonium nitrate for row crops. Where the application of nitrogen at depths of 4 to 6 inches is superior to shallower applications, ammonia may be applied at these depths more easily than can solid sources of nitrogen.

For small grains ammonia is a good source of nitrogen; however, there are problems connected with its application in the spring to fall-planted small grain which may limit its use.

Ammonia will kill germinating seed if it comes in contact with them. In two known cases farmers have applied ammonia in the zone where the seed were later placed and poor stands of cotton resulted. However, where ammonia has been placed 4 to 6 inches below the planting depth of the seed no injuries to the germinating seed have been obtained.

The data on crop response to ammonia and information on the equipment for applying it were made available on March 7. At that time no equipment was available for applying it. At the present time there are more than 200 machines for applying ammonia, most of which are in Mississippi. It is anticipated that ammonia will be applied to more than 100,000 acres this year.

With the equipment which is now in use for applying anhydrous ammonia and solid sources of nitrogen, farmers can apply anhydrous ammonia with one man and a tractor to about twice as many acres as can be fertilized by two men and a tractor with solids. The acreage covered per day with anhydrous ammonia is 35 to 60 acres.

Both anhydrous ammonia and aqua ammonia are suited for pre-planting or side-dressing applications. Anhydrous ammonia has been applied in the following operations by farmers in the Mississippi Delta:

(1) Before planting on level land. (2) Before planting on bedded land. (3) Before planting and bedding simultaneously with listers. (4) As a side dressing.

In side dressing with ammonia it is recommended (without data) that it be applied not more than six inches from the plants. Where ammonia is applied in the water furrow in side dressing it is recommended that it be plowed out toward the plants after it has been in the soil for one week.

Ammonia as a Source of Nitrogen

A Progress Report on Crop Response to Anhydrous Ammonia and Aqua Ammonia, and on Equipment and Methods of Application

By W. B. ANDREWS, F. E. EDWARDS, and J. G. HAMMONS[1] [2]

Until about 100 years ago farmers depended upon animal manure, green manure crops, and crop rotations to supply nitrogen to crops. During the last century nitrogen has been obtained in commercial forms: first from Chile, next as a by-product from the coking industry, and more recently from the air by synthetic nitrogen fixing plants.

This nitrogen obtained from the air is treated with hydrogen under high pressure and in the presence of iron rust to form ammonia which contains 82 percent nitrogen.

Ammonia is then used in the manufacture of several common types of solid nitrogen fertilizers such as ammonium nitrate, nitrate of soda, and urea. The cost of the manufacturing processes which are required to change ammonia into a solid nitrogen fertilizer acounts for about half of the total cost of the product.

Since the application of ammonia directly to the soil offered possibilities of obtaining nitrogen fertilizer at a great reduction in cost, work was started by the Mississippi Agricultural Experiment Station in 1943 to determine crop response to ammonia as a source of nitrogen.

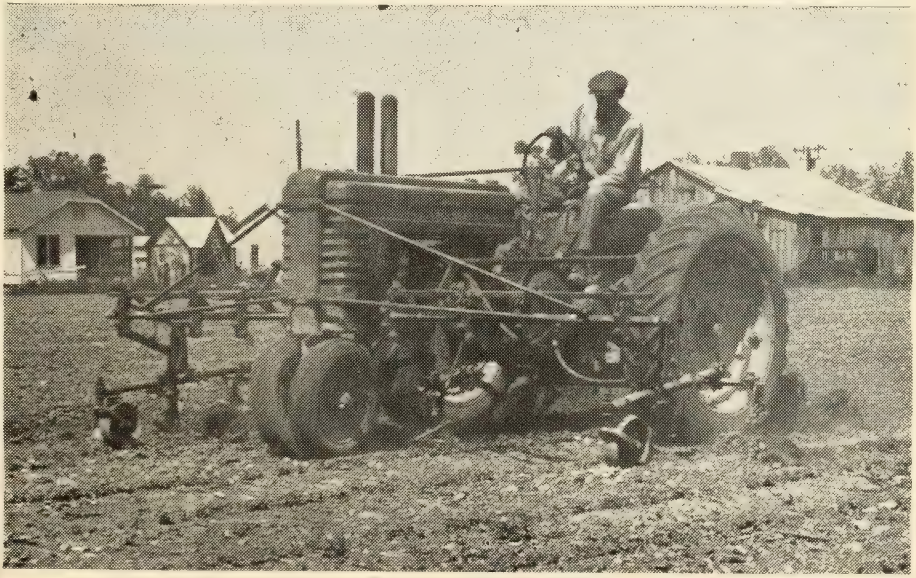

Figure 1. Side dressing cotton with anhydrous ammonia. Note relation of sweep to applicator.

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[2] P. H. Grissom, John Pitner, William E. Meek of the Delta Branch Experiment Station, and S. P. Crockett of the North Mississippi Branch Experiment Station cooperated in collecting crop data included in this report.

The research program, supported jointly by the Mississippi Station and the Tennessee Valley Authority, included the development of suitable equipment for applying ammonia to the soil, of laboratory studies on the behavior of ammonia in the soil, and of measuring the efficiency of the ammonia in terms of crop yields.

As a result of experiments conducted during the past four years it has been determined that ammonia is a good nitrogen fertilizer, if it is applied properly.

Properties of Anhydrous Ammonia

At atmospheric pressure and normal temperatures ammonia is a gas. It exists as a liquid below —28° F., and boils at this temperature. At 50° F. it has a pressure of 75 pounds per square inch. At 100° F. it has a pressure of 197 pounds per square inch. The pressure is about the same as that for commercial propane, which is used for flame cultivation, and anhydrous ammonia may therefore be handled in propane equipment. Butane equipment, which is unsatisfactory for propane, is also unsatisfactory for anhydrous ammonia. The precautions needed with propane are necessary with anhydrous ammonia, except there is little danger from ammonia catching on fire. There should be no chemical reaction between ammonia, and any left-over butane or propane. Preferably, tanks should be left open a few days and blown before changing from one to the other.

Properties of Aqua Ammonia

Anhydrous ammonia may be diluted with water to give a 30 percent ammonia solution. This solution has no pressure except at high temperatures. Ammonia diluted with water, and anhydrous ammonia, have equal value for crop production.

Cost of Nitrogen in Various Forms

Ammonia is the cheapest form of nitrogen available. At the present time, the retail cost of nitrogen from different sources is approximately:

Source of nitrogen	Cost per pound of nitrogen
Anhydrous ammonia	6 cents
Ammonium nitrate	10 cents
Cyanamid	13 cents
Nitrate of soda	16 cents

There are patents on the use of anhydrous ammonia, and on equipment for applying it.

Crop Response to Ammonia and Ammonium Nitrate

When properly applied as a fertilizer, ammonia goes into solution in the soil water, from which it combines with the clay. While ammonia is on the clay it does not leach out of the soil; however, it comes off of the clay particles sufficiently rapid to supply crops with nitrogen.

Young corn and cotton plants prefer ammonia to nitrate nitrogen, and they grow off more rapidly when ammonia nitrogen is applied before planting than when nitrate nitrogen is applied before planting. Older plants prefer nitrate nitrogen. When only nitrogen is considered, preplanting application of ammonia to supply young plants with ammonia, which later is changed to nitrate for the older plants, is ideal.

If ammonia is to be used to give young plants a quick start, it is necessary that it be applied immediately before planting or while the plants are small. If ammonia is to be applied in the spring several weeks in advance of planting, it will be changed over to nitrates on fertile soils before the plants can use it as ammonia.

When crops are exposed to the fumes of ammonia from either anhydrous ammonia or aqua ammonia the leaves are killed; however, the buds are usually not affected and growth continues. Young cotton plants are killed out right by the fumes of ammonia. In side dressing with ammonia, it should be applied and

Table 1. The response of cotton to anhydrous ammonia and ammonium nitrate at several locations in 1945-1946.

Location	Source of nitrogen, pounds per acre, depth of application in inches, and time of application								
	Ammonium nitrate 32 lbs. 4" preplant	Anhydrous ammonia 32 lbs. 4" preplant	Anhydrous ammonia 32 lbs. 6" preplant	Anhydrous ammonia 32 lbs. 4" side dress	Ammonium nitrate 32 lbs. 4" side dress	Ammonium nitrate 32 lbs. surface side dress	Check no Nitrogen	Anhydrous ammonia 64 lbs. 4" preplant	Anhydrous ammonia 64 lbs. 6" preplant
	Yield in pounds of seed cotton per acre								
1945:									
Greenwood	1310	1175	1432	1338	1433	1410	1013	1240	1303
Lambert	2160	2130	2443	2375	2370	2297	2013	2660	2607
Columbus	953	1150	1072	1100	1177	1143	703	1343	1180
Holly Springs	1907	1942	1923	1860	1875	2002	1433	2237	2240
Tomnolen	1485	1710	1720	1350	1470	1510	1130	1440	1380
Columbus	1263	1352	1507	1458	1302	1423	1120	1320	1453
Indianola	1593	1723	1707	1563	1503	1583	1523	1633	1663
1946:									
Indianola	1785	1710	1690	1630	1725	1720	1205	1945	1860
Holly Springs	1270	1274	1412	1308	1264	1258	756	1362	1520
Lambert	2127	2353	2183	2190	2177	2073	1983	2313	2290
Starkville	1473	1568	1487	1487	1565	1472	1148	1455	1373
Tomnolen	1215	1265	1408	1228	1353	1188	755	1310	1323
Aberdeen	430	453	527	407	417	503	217	563	643
Average: all tests	1459	1523	1578	1484	1510	1506	1154	1602	1603
Average: 12 tests	1471	1552	1590	1496	1516	1514	1166	1632	1628

covered in such a manner that the crops are not exposed to the fumes.

It is desirable that ammonia be applied where it is to stay; however, occasionally farmers may find it desirable to plow it up for some reason. After ammonia has been in the soil for about four days it should be fixed so that no loss of nitrogen occurs on plowing it up. If it is applied five or six inches deep it should not be disturbed by shallow cultivation.

The Response of Cotton to Anhydrous Ammonia and Ammonium Nitrate

In twelve tests with cotton where ammonia and ammonium nitrate were applied side by side, 62 times, at a depth of 4 inches before planting, ammonium nitrate increased the yield 305 pounds of seed cotton per acre and ammonia increased the yield 386 pounds per acre. The odds are more than 19 to 1 that this difference was due to the superiority of anhydrous ammonia over ammonium nitrate.

The 6-inch depth of application of ammonia increased the yield 424 pounds of seed cotton per acre. Data collected at Stoneville also indicate that a 6-inch depth is superior to a 4-inch depth of application.

In one other test where the soil was in such poor physical condition that the ammonia could not be completely sealed at the 4-inch depth, ammonia was inferior to ammonium nitrate; however, the 6-inch depth of application of ammonia was superior to ammonium nitrate at the 4-inch depth.

In seven tests with cotton conducted in cooperation with the Delta Branch Experiment Station, the yield of seed cotton was 2,091 pounds per acre from ammonium nitrate and 2,046 pounds per acre from anhydrous ammonia. These data show that ammonium nitrate produced slightly more seed cotton than anhydrous ammonia. However, the variations in the yield of cotton obtained were such as to suggest that there was no

Table 2. The response of cotton to anhydrous ammonia and ammonium nitrate.

Location	Years of test	Soil	Yield in pounds seed cotton per acre: Check	Ammonium nitrate	Anhydrous ammonia
Stoneville	2	Sandy loam	1923	2423	2338
Stoneville	1	Buckshot	1283	1830	1687
Yazoo City	1	Sandy loam	1283	1509	1541
Hemphill	2	Silt loam	1174	1565	1413
Money	2	Loam	1605	2010	1843
Stoneville	2	Sandy loam	1582	2354	2377
Average			1475	1949	1867

difference in the efficiency of these two sources of nitrogen in these tests.

When nitrogen was applied as a side dressing to cotton, the following yields were obtanied in the 12 tests which contained 62 side-by-side comparisons:

Source of nitrogen	Increase pounds seed cotton per acre
Ammonia, 4" deep	330
Ammonium nitrate, 4" deep	350
Ammonium nitrate, surface	348

These tests were conducted in 1945 and 1946 when rainfall was ample.

In 1944 when dry weather prevailed, ammonia applied 5 inches deep as a side dressing was much superior to surface-applied ammonium nitrate in most tests, and a large number of tests were conducted. The difference in favor of ammonia in the side dressing experiments on the dry year is attributed entirely to depth of placement.

The Response of Corn to Anhydrous Ammonia and Ammonium Nitrate

When anhydrous ammonia and ammonium nitrate were compared in 13 tests the following data were obtained:

Source of nitrogen	Depth of application	Increase in yield, bushels per acre
Anhydrous ammonia	4"	15.4
Ammonium nitrate	4"	13.7
Ammonium nitrate	surface	12.8

The above data on corn were collected in 1945 and 1946 when rainfall was excessive.

In 1944, when rainfall was very low, anhydrous ammonia applied at a depth of approximately 5 inches, usually gave much greater increases in yield than ammonium nitrate applied on the surface. The ammonia was applied in the root zone where it was available to the plants, while the ammonium nitrate applied on the sur-

Table 3. The response of corn to anhydrous ammonia and ammonium nitrate, 1945 and 1946.

Location	Source of nitrogen, rate, depth, and time of application: Ammonium nitrate 32 lbs. 4" preplant	Anhydrous ammonia 32 lbs. 4" preplant	Anhydrous ammonia 32 lbs. 6" preplant	Anhydrous ammonia 32 lbs. 4" side dress	Ammonium nitrate 32 lbs. 4" side dress	Ammonium nitrate 32 lbs. surface side dress	Check, no nitrogen	Anhydrous ammonia 64 lbs. 4" preplant	Anhydrous ammonia 64 lbs. 6" preplant
	Yield in bushels of corn per acre								
Columbus	24.2	28.3	27.8	27.4	27.8	28.5	12.1	38.9	37.7
Starkville	21.8	26.0	29.1	34.6	28.7	26.2	12.4	38.4	40.2
Tomnolen	55.3	56.1	55.9	57.8	55.3	54.6	42.8	60.6	61.8
Holly Springs	82.8	84.6	82.4	79.1	79.5	80.6	69.9	84.8	77.8
Holly Springs	66.3	60.5	66.7	69.5	62.3	63.7	56.0	72.8	69.8
Average	50.1	51.1	52.4	53.7	50.7	50.7	38.6	59.1	57.5

face was unavailable until rain carried it into the root zone.

On the basis of the data presented, it is reasonable to conclude that ammonia as a source of nitrogen is at least as good as ammonium nitrate.

Where depth of placement and uniformity of application are factors in crop production, ammonia has advantages over ammonium nitrate and other solid nitrogen fertilizers.

Table 4. Anhydrous ammonia and aqua ammonia vs ammonium nitrate for side dressing crops on a dry year.

Location and source	Increase in yield	
	Cotton lbs./A	Corn bu./A
Holly Springs		
Ammonium nitrate	201	7.4
Aqua ammonia	205	6.8
Eupora		
Ammonium nitrate	175	8.2
Anhydrous ammonia	193	10.8
Marks		
Ammonium nitrate	92 (180)[1]	2.2
Anhydrous ammonia	242 (305)[1]	5.6
State College		
Ammonium nitrate	—	8.6
Anhydrous ammonia	—	12.5
State College		
Ammonium nitrate	—	4.5
Anhydrous ammonia	—	13.8
Tomnolen		
Ammonium nitrate	—	13.0
Anhydrous ammonia	—	13.4
Shuqualak		
Ammonium nitrate	104	3.4
Anhydrous ammonia	258	6.2
Valley Hill		
Ammonium nitrate	—	7.2
Anhydrous ammonia	—	10.0
Heathman		
Ammonium nitrate	48	—
Anhydrous ammonia	98	—
Stoneville		
Ammonium nitrate	159	—
Anhydrous ammonia	305	—
Stoneville		
Ammonium nitrate	125	—
Anhydrous ammonia	105	—
Yazoo City		
Ammonium nitrate	225	—
Anhydrous ammonia	207	—
Valley Hill		
Ammonium nitrate	215	—
Anhydrous ammonia	263	—

[1] The first figures are for the first picking. The second picking was lost. The figures in parenthesis are based upon boll count.

The Response of Oats to Anhydrous Ammonia

Top dressing small grains with ammonia presents problems which are not present in row crop fertilization. Fall planted oats apparently use nitrate and ammonia nitrogen equally well in the fall. However, in the spring nitrogen applied as ammonia must be changed into nitrate nitrogen before it is used by oats.

The acidity of the soil as measured by pH is closely associated with rate of nitrification. Nitrification was found to be slow in soils with a pH of 5.1 or less, and rapid in soils with a pH of 5.5 or higher. The data shown in table 6 were obtained for fall applied ammonia as compared to spring applied ammonia nitrate. In soils of pH 5.1 or lower the rate of nitrification was slow and fall applied ammonia was retained by the soil through the winter, and gave larger yields than spring applied ammonium nitrate. In soils with a pH of 5.5 or higher the rate of nitrification was rapid and part of the fall applied ammonia was changed to nitrate nitrogen and was leached out before spring, and lower yields were produced from ammonia applied in the fall than from spring applied ammonium nitrate.

On one soil with a pH of 4.95 the following data on oats were obtained:

Source of nitrogen	Time of application	Increase in yield-bu. oats per acre
Ammonia	October	28.9
Ammonia	January	30.2
Ammonia nitrate	March	26.8

On this soil October and January were satisfactory dates for applying ammonia.

On one soil with a pH of 5.1 the following data on oats were obtained:

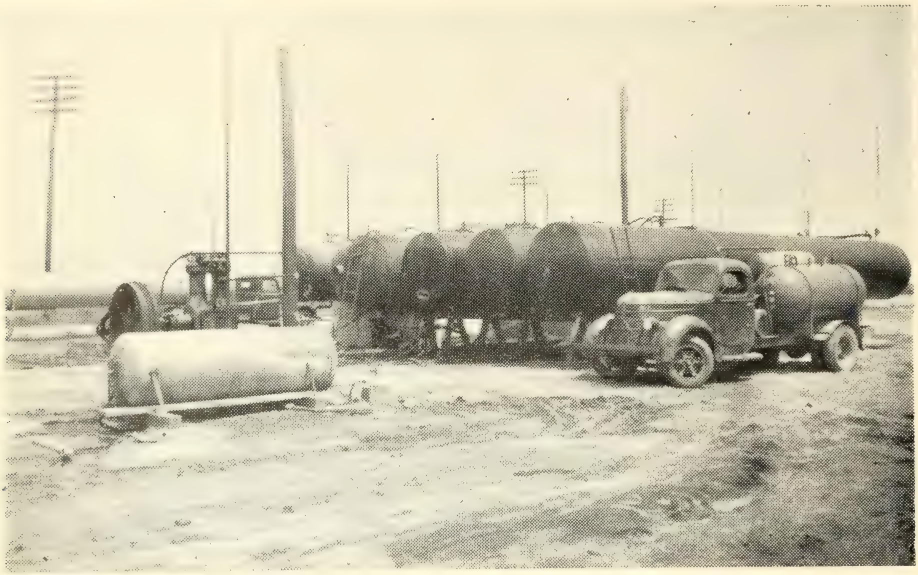

Figure 2. Anhydrous ammonia bulk storage. Note two anhydrous ammonia transport trucks, and compressor.

Source of nitrogen	Time of application	Increase in yield-bu. oats per acre
Ammonia	March	18.5
Ammonia nitrate	March	19.6
Ammonia	October	10.4

The March application of ammonia on this soil was too late for the ammonia to be changed over to nitrates in time for oats to make maximum use of the nitrogen.

On a soil with a pH of 7.8 the following data on oats were obtained:

Source of nitrogen	Time of application	Increase in yield-bu. oats per acre
Ammonia	October	8.5
Ammonia	March	25.1
Ammonium nitrate	March	23.9

The ammonia was changed to nitrate nitrogen rapidly on this soil and March application was satisfactory. The fall application of ammonia was unsatisfactory.

More data are needed on the fertilization of oats with ammonia. However, the data presented suggest that ammonia should be applied to soils with a pH of 5.1 or less before February, and that on soils with a pH greater than 5.1 ammonia should be applied after February 1.

Ammonia was applied in bands of 15 or 16 inches apart and about 5-inches deep in the above tests. Some data are available which indicate that a wider spacing is satisfactory; however, more data are needed.

Ammonia is superior to ammonia nitrate for fall application to oats planted for grain production. In tests planted for grain the yields are reported in table 7.

The unused nitrogen from ammonia is retained for spring growth to a much greater extent than if the nitrogen were ammonium nitrate.

Ammonia was equal to ammonium nitrate on oats planted in the fall for grazing (table 8). The data show little difference between anhydrous ammonia and ammonium nitrate for the production of forage by fall planted oats. However, they do show that high rates of nitrogen

Table 5. The response of corn to anhydrous ammonia and ammonium nitrate applied as a side dressing for 1945 and 1946.

	Source of nitrogen, rate per acre, and depth of application						
Location	Check no nitrogen	Anhydrous ammonia 32 lbs. 6"	Anhydrous ammonia 32 lbs. 4"	Ammonium nitrate 32 lbs. 4"	Ammonium nitrate 32 lbs.	Anhydrous ammonia 64 lbs. 4"	Anhydrous ammonia 64 lbs. 6"
	Yield in bushels per acre						
West Point	54.1	59.2	60.3	58.2	59.6	68.3	65.4
State College	61.8	75.9	73.2	73.8	68.6	79.8	84.8
State College	33.8	41.4	37.3	40.8	35.2	43.5	47.2
Starkville	11.7	34.6	33.8	28.1	27.4	39.4	40.1
Columbus	13.6	37.1	36.1	34.2	35.1	46.2	49.9
Aberdeen	19.3	44.1	42.3	40.6	35.2	54.0	51.4
Columbus	5.6	34.3	34.7	33.0	33.9	48.4	47.6
Starkville	40.3	46.2	47.0	48.8	50.9	56.3	57.4
Average	30.0	46.6	45.6	44.7	43.2	54.5	55.5

Table 6. The response of oats for grain to fall-applied ammonia.

Number of tests	pH of soils	Rate of nitrification	Increase in yield-bushel oats per acre	
			Ammonia fall	Ammonium nitrate spring
5	5.1 or lower	Slow	28.0	23.6
5	5.5 or higher	Fast	14.0	23.5

Table 7. The response of oats to fall-applied ammonia and ammonium nitrate

	Source of Nitrogen	
Test number	Anhydrous ammonia	Ammonium nitrate
	Increase in yield—bushels oats per acre	
1	30	16
2	32	15
3	30	16
4	29	20
5	19	10
6	25	15
7	12	8
8	15	8
9	14	10
10	4	4
Average	21	12

are essential. The data presented above on fall applied ammonia and ammonium nitrate to oats for grain production show that the unused nitrogen from ammonia is carried over until spring, when grain is produced, better than that from ammonium nitrate. It appears that anhydrous ammonia and aqua ammonia are ideal sources of nitrogen for fall planted small grains which are to be used for grazing. These materials may be applied conveniently to oats before planting.

Equipment for Storing and Applying Anhydrous Ammonia

The development of a machine to apply anhydrous ammonia was started at the Mississippi Agricultural Experiment Station in 1944.

The first equipment used for applying anhydrous ammonia was a 1-row machine. It consisted of a side-mounted standard 100-pound anhydrous ammonia tank, atlantic seamless steel high pressure hose

Table 8. The response of oats for grazing to anhydrous ammonia and ammonium nitrate.

Farm and cutting date	Source of nitrogen and rate per acre			
	Anhydrous ammonia 32 lbs.	Ammonium nitrate 32 lbs.	Ammonium nitrate 64 lbs	Anhydrous ammonia 64 lbs
	Pounds of oven dry oats per acre			
Rush 12/3/46	759	707	1147	1162
Rush 2/14/47	185	161	233	239
Total	944	868	1380	1401
Porter 12/5/46	481	281	494	863
Porter 2/14/46	138	100	209	213
Total	619	381	703	1076
Guin 12/4/46	737	598	1394	1343

feed line, rotameter (recommended for experimental work) and mounting, control globe valve, distribution line, and applicator shank. This equipment was mounted on a tractor equipped with a 2-row cultivator.

Later, 2-row and 4-row equipment was developed. The tank mounting was changed to the rear of the tractor to facilitate loading of 150-pound capacity anhydrous ammonia tanks. A report on this machine, which was designed for research, has been accepted for publication in June or July issue of the Journal of the American Society of Agricultural Engineers.

The present equipment for applying anhydrous ammonia on the farm was developed as a result of the experience obtained with the research machine described above. In changing the research machine over to a more practical type farm machine, the following changes were

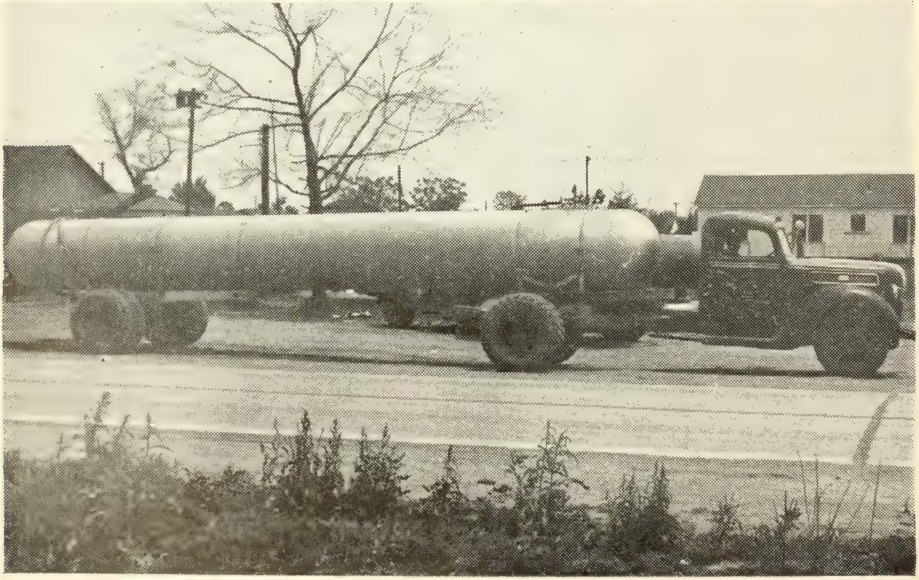

Figure 3. Anhydrous ammonia transport truck. Capacity 3,000 gallons.

made: (1) the propane flame cultivator tank and mounting was used instead of the standard 150-pound capacity anhydrous ammonia cylinder, (2) a differential pressure regulating valve and gauge, or needle valve and gauge, was used to replace the rotameter for metering, and (3) the number and size of orifices in the manifold was changed.

Setting Up Field Equipment

Propane storage and tractor tanks, which meet Mississippi specifications, are satisfactory for the handling of anhydrous ammonia. (Table 9). However, it is necessary to change the bronze valves and fittings used with propane to special iron or steel valves and fittings for handling anhydrous ammonia.

All fittings should be built for a working pressure of 250 pounds per square inch. Storage and tractor tanks should have a working pressure of 200 pounds per square inch if tested according to the Mississippi specifications for propane tanks. With a less strenuous test, higher pressure tanks should be used. Specifications for over-the-road tanks will be made by the Interstate Commerce Commission.

The farm storage tanks may be mounted permanently or they may be mounted on trailers or a combination may be used. The same type fittings are used on storage and tractor tanks. At present, the most commonly used storage is 1000-gallon tanks mounted on trailers. The tractor mounted tank is customarily of 80 to 110 gallons in capacity.

Table 9. Gauge pressure of anhydrous ammonia and propane in pounds per square inch (From Mark's Handbook.)

Temperature degrees, Fahrenheit	Anhydrous ammonia gauge pressure	Propane gauge pressure[1]
20	33	41
30	45	51
40	55	63
50	74	76
60	93	92
70	114	109
80	138	128
90	166	149
100	197	172
110	232	197

[1] Propane as used contains some ethane and its actual pressure is essentially the same as that of anhydrous ammonia.

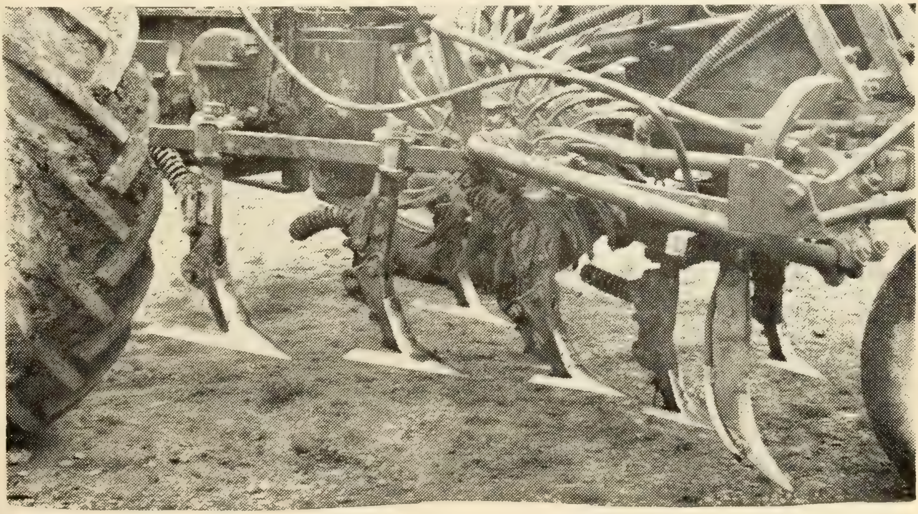

Figure 4. Anhydrous ammonia equipment mount, in addition to two row cultivating equipment. Note ammonia applicator, and rotary hoe for preventing the covering of small plants.

The fittings for the tanks are as follows:

1. 300-pound gauge.
2. A ¼ to ½ inch gas outlet valve with short pipe extending into the tank which should not permit filling to over 90 percent capacity. This valve may also be used for gas escape in filling by bleeding.
3. A ¾ to 1 inch vapor return valve for filling with a pump or compressor.
4. Safety or pop-off valves. Size: Storage tank 1½ inch; tractor tank, ¾ to 1 inch; setting, 250 pounds per square inch.
5. A ¾ to 1 inch liquid inlet filling valve.
6. Liquid outlet feed valve connected to a down pipe equipped with a 1/64 inch mesh strainer. Size: storage tank ¾ to 1 inch; tractor ½ to ¼ inch.
7. A standard glass gauge graduated in gallons per hour.

The glass gauges indicate the amount of ammonia in the tanks. In the tractor the gauge is located on the side of the tank next to the tractor. It should be shielded for the driver's protection and should be enclosed in a very heavy clear plastic tube with drain holes at the bottom. This same type gauge should be used on the storage tank and its location will depend upon the build of the tanks.

Metering Equipment

At the present time a differential pressure regulating valve or needle valve and pressure gauge is used for metering or regulating the flow of anhydrous ammonia through orifices in the manifold. A short nipple connects the tank feed line valve to a quarter turn cut-off valve which is connected to the regulator valve. The manifold connects to the low pressure side of the regulator valve. The regulator valve should be built to withstand 250 pounds pressure per square inch on the tank side and 100 pounds per square inch on the manifold side. The manifold is made of short tees, elbows, and anhydrous ammonia flange unions into which the orifices are fitted. After this metering system was built, it was calibrated by the rotameter to give the readings in table 13.

When one applicator is used per row the size of the orifices is 3/32 of an inch. When the application is made with middle busters or listers or other equipment where two applicator furrows are made per row, the orifices feeding these lines should have one-half of the area and not one-half of the diameter of 3/32 orifices. The diameter of the one-half sized orifice is approximately 1/16 inch.

The feed lines leading from the manifold to the applicators should be 150-pound test ¼-inch rubber air hose.

Anhydrous ammonia has been applied in the following operations in the Mississippi Delta:

1. Before planting on prepared level land, in which the applicators are mounted on cultivator frames and the ammonia is sealed with disc hillers.
2. Before planting on bedded land, in which the applicators are mounted on cultivator frame and the ammonia is sealed by disc hillers.
3. Before planting while bedding with listers, which seal the ammonia.
4. In the planting operation, in which the applicators are mounted on the cultivator frame.
5. In side dressing, in which the applicators are mounted on cultivator frame and the ammonia is sealed with a disc hiller or by the cultivator sweeps.

The number of applicators and size of orifices for the different types of operations are shown in table 10.

The applicators should be run to a depth of 5 to 6 inches; and the disc hillers, where used, should be set at approximately half the depth of the applicators so that they will completely seal the ammonia. If it is desired to apply ammonia to small grain the applicators should be run 5 to 6 inches deep and spaced 16 inches apart.

There is some difficulty in sealing the material in top dressing oats and research is being continued on the development of satisfactory sealing methods.

Construction of Applicators

During the process of machinery development, several different types of applicators were built. The most satisfactory one was made from a ½-inch x 2-inch steel bar. The width of the bar stock was reduced by cutting out ¼-inch in the middle of the front and tapering the cut out at each end. The bar stock was cut at a 30-degree angle at the bottom. The applicator was curved and drawn out to a knife edge at the front, and a ¾-inch x 1-inch suction point was drawn out at the bottom. When the applicator is curved properly, there should be a horizontal distance of 8½ inches between the point of the applicator and a vertical line drawn from the back side of the top of the applicator to the level of the point. This curve should gradually blend out at 4½ inches from the top of the applicator.

The standard is round and about 4½ inches long. The fork holder is of two pieces of ½-inch x 2-inches x 4½-inches bar steel welded to each side of the standard separated by a distance of ½-inch to take the applicator. The applicator

Table 10. Number of applicators and sizes of orifices for different types of operations.

Type of operation	Number of applicators	Number of orifices	
		Full size	Half size
1. Before planting on level land	Same as number of rows	All	—
2. Before planting on bedded land	Same as number of rows	All	—
3. Lister application	5	3	2
4. Planting operation	Same as number of rows	All	—
5. 3-row middle buster	6	—	6
6. Split row, two bottom middle buster	4	—	4
7. Two bottom middle busters	3	1	2

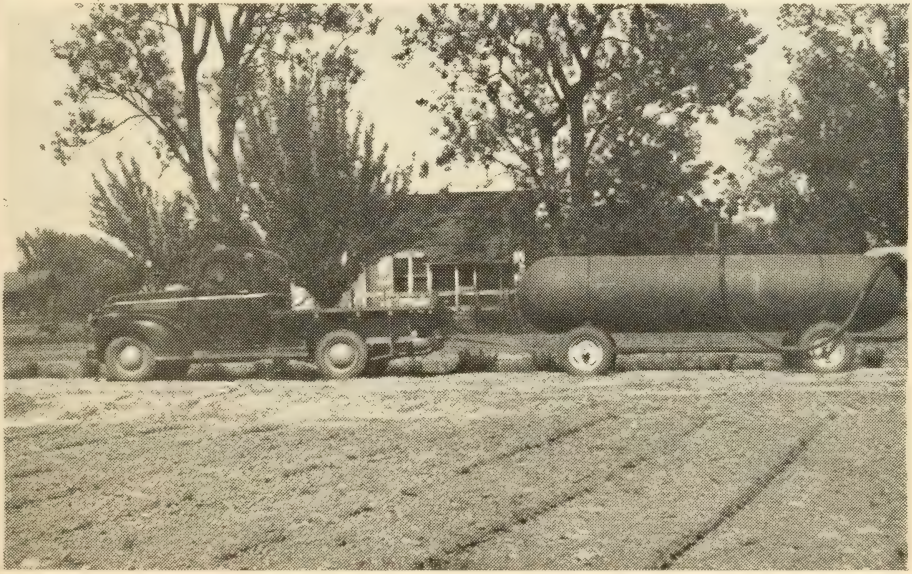

Figure 5. Moving 4,100 pounds of nitrogen as anhydrous ammonia with a pick-up truck.

should be set at a 15-degree angle with the fork holder. The overall vertical height of the applicator, holder and standard should be 19 to 20 inches. The applicator is placed in the fork, after which suitable holes spaced 2½ inches apart are drilled. The upper hole is drilled for a 3/16-inch bolt, while the lower hole is drilled for a ½-inch bolt. Bolts placed in these holes fasten the applicator in the fork that is welded to the round standard, and the 3/16-inch bolt at the top acts as a break pin.

A ⅝-inch pipe through which the feed hose passes is spot-welded at the top and bottom to the back of the knife. The pipe should not come closer than 3 inches to the bottom of the fork and 1½ inches above the point of the applicator.

The pipe should be split up ¾-inch from the bottom and cut off, leaving a small strip that can be bent down to clamp the hose to the applicator. The hose is cut at a 30 degree angle at the bottom. It should have 1½ inches clearance when the applicator is set in operating position. After the hose has been cut and clamped at the bottom, the pipe should be flattened in order to decrease the wear on it and hold the hose in the pipe.

Table 11. Possible loss of anhydrous ammonia that may be obtained when filling by bleeding off of a 360-pound capacity tank.

Temperature of tractor tank	Gauge pressure at beginning	Pressure differential	End temperature of tractor	Gauge pressure reading at end	Ammonia loss	
Degrees F.	Pounds	Pounds	Degrees F.	Pounds	Pounds	Percent*
110°	232	232	—28	0	133	36
110°	232	40	99	192	11	3
110°	232	20	105	212	6	1.8
110°	232	10	107	222	3	.9

*These calculations include the cooling of the tractor tank, weight of which is 400 pounds.

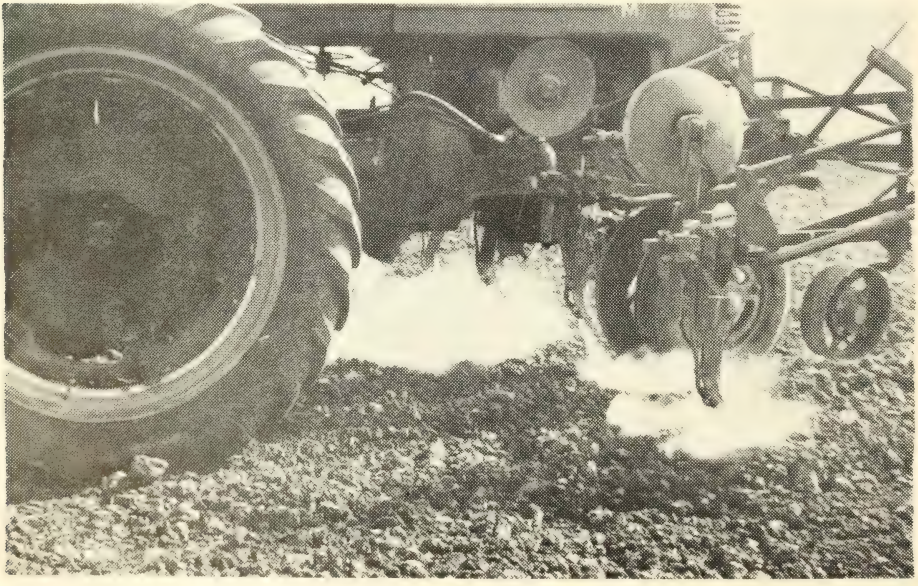

Figure 6. Checking applicators to see that all of them are applying anhydrous ammonia. Note the fog of ammonia, which is not present when the applicators are moving in the soil.

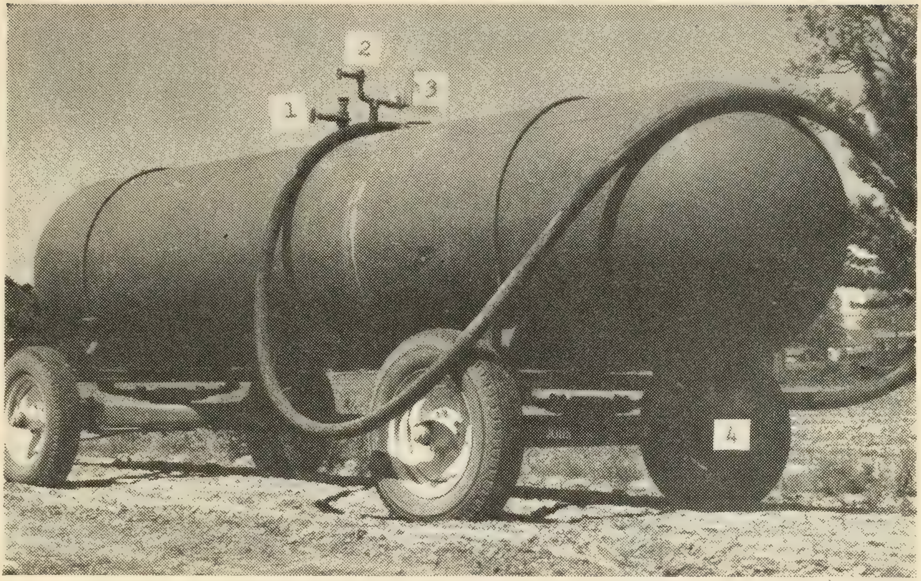

Figure 7. Field transport tank for anhydrous ammonia. Capacity 1000 gallons containing 4100 pounds of nitrogen—102 acres at 40 pounds per acre. (1) Filling valve. (2) Bleed-off valve with stationary fill depth pipe in tank. (3) Pop-off valve. (4) Liquid outlet and valve. (5) Liquid transfer.

Filling Operation

The ways of filling tanks with anhydrous ammonia are as follows: (1) by bleeding gas off the tank being filled with the liquid line connected between tanks, (2) by pumping the liquid with the vapor line connected between tanks, and (3) by compressing the gas vapor from the tank being filled into the storage tanks with the liquid line connected.

Bleeding off to fill tanks is carried out in the following order: (1) connect the vapor hose to the tractor tank, (2) connect the liquid line between the tanks, (3) barely open the vapor valve on tractor tank, (4) open the liquid valve on tractor tank, (5) open the liquid valve on the hose line next to the tractor tank (if not already open; it should be open), (6) open the valve on liquid line on the storage tank, and (7) continue to open the vapor valve on the tractor tank until the pressure gauge shows 10 to 20 pounds less pressure than is shown by the gauge on the storage tank. If a greater pressure differential is obtained, one may expect a greater loss of ammonia, as shown in table 11.

The recommended difference in gauge reading 10 to 20 pounds will give a very low loss of from 1 to 2 percent, yet this difference should give a very quick filling time. If bleeding is rapid enough to accumulate moisture on the tank, and particularly for ice to form on the tank, the loss of ammonia is excessive. In fact, bleeding to atmospheric pressure may result in a loss as high as 36 percent of the total ammonia.

When the tank is filled to 90 percent of capacity, a white spray will start escaping from the vapor line. When the white spray starts, the valve on the liquid line on the storage tank should be closed at once. Then the vapor line valve on the tractor tank followed by the liquid hose valve next to the tractor should be closed, after which the filling valve on the tractor tank is closed. The union should then be loosened and the ammonia in the short nipple should be drained before the connection is completely broken. The filling hose should be drained in order to prevent accidents such as bursting of the hose or releasing ammonia on the operator while making connections.

In filling with the pump, the procedure should be in the following order: (1) connect the vapor hose line to the vapor outlets, (2) open valves on vapor line, (3) connect the liquid line, (4) open the fill valve on the tractor tank, (5) open the liquid line valve next to the tractor tank, (6) open the liquid line valve on the storage or field tank, (7) open the depth fill gauge valve on tractor tank and (8) start the pump.

As soon as the white spray starts to escape from the vapor valve the pump should be cut off, and the valves closed in the following order: (1) liquid valve on storage tank, (2) vapor valve on storage tank, (3) vapor valve on tractor tank, (4) disconnect vapor line connection on tractor tank, (5) close depth gauge valve on tractor tank, (6) close liquid valve on hose line next to tractor tank, (7) close fill valve on tractor tank, (8) loosen liquid line connection on tractor tank and let the material in the short nipple drain out. The line is then completely disconnected and drained.

In filling with a compressor, the operation of valves and connections are the

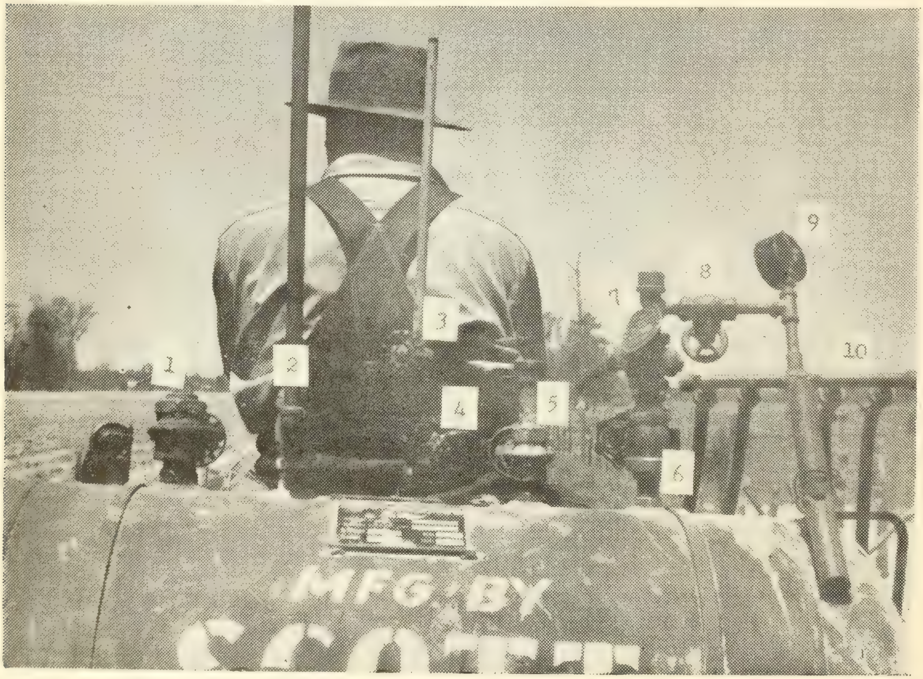

Figure 8. Fittings for anhydrous ammonia tractor tank. **(1) Vapor line return valve for filling with pump or compressor. (2) Pop-off valve with stand pipe. (3) Bleed-off and stationary fill gauge valve and stand pipe. (4) Tank pressure gauge. (5) Filling valve. (6) Feed line valve. (7) Quick cut-off valve. (8) Regulating needle valve. (9) Low pressure gauge. (10) Manifold.**

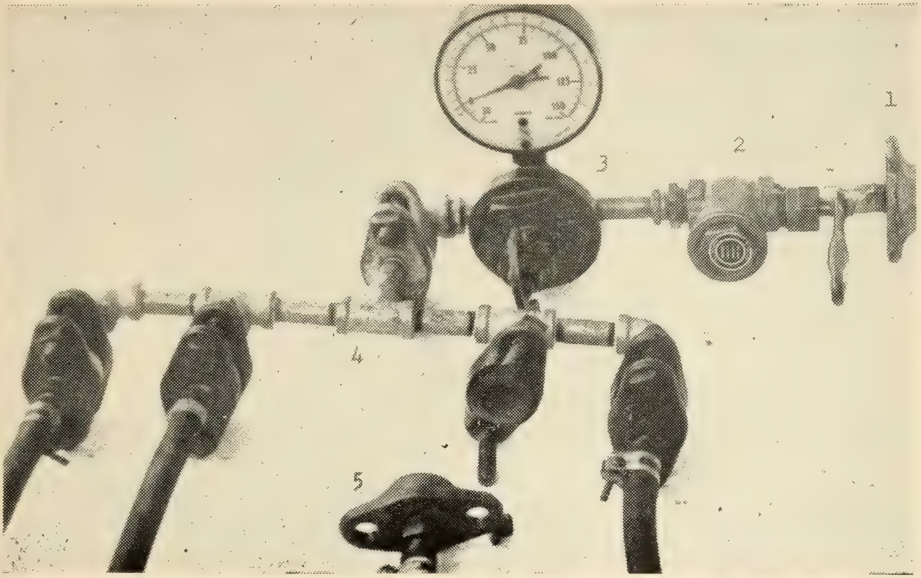

Figure 9. **Mechanism for regulating the flow of anhydrous ammonia. (1) Connection to tractor tank. (2) Quick cut-off valve. (3) Regulating valve with gauge. (4) Manifold for 4 rows—overall length 14 inches. (5) Flange containing 3/32" orifice.**

same as in filling with the pump except the compressor is connected into the vapor line.

Operating the Tractor Equipment

The first step in the operation of the field machine is to determine the rate of ammonia to be applied per hour. The amount of ammonia to be applied is regulated by the use of a differential pressure regulating valve. The rate of delivery of ammonia is in relation to time and not to the speed of the tractor. Consequently, the speed of the tractor must be determined.

To find the speed of the tractor in feet per second: first, set the applicators and covers at the correct depth to completely seal the ammonia (6 inches below the seed level is recommended); second, make a trial run to get the correct throttle, covers, applicator, and gear setting; third, measure off a distance of 300 to 500 feet and record the time required to cover this distance; fourth, divide the distance in feet by the time in seconds, which gives feet per second.

After the speed of the tractor in feet per second has been determined, the pounds of ammonia per hour may be obtained from table 12. As an example, the table shows that 340 pounds of ammonia per hour is required to give 40 pounds of nitrogen per acre with rows 42 inches wide and a tractor speed of 5.88 feet per second. The table is made up for 4-row equipment, and the pounds of ammonia per hour should be divided by two for 2-row equipment.

The rate of ammonia per hour was calculated by the following formula: speed of tractor in feet per second x 3,600 x number of rows x row width in feet x pounds of nitrogen per acre divided by 43,560 times 0.83 as shown below: 5.88 x 3,600 x 4 x 3½ x 40 divided by 43,560 x 0.82 equals 332 pounds of ammonia per hour. Since the table is set up in 20-pound divisions the table shows 340 instead of 332.

Table 12. The pounds of ammonia per hour required for different rates of nitrogen with different row width and tractor speeds.

Rate in pounds nitrogen per acre (speed of tractor feet per second)	Four row equipment			
	Pounds of anhydrous ammonia per hour for 40 pounds of nitrogen per acre			
	Row width 36″	Row width 38″	Row width 40″	Row width 42″
2.0 miles per hr. x 1.47 = 2.94 ft./sec.	140	150	160	170
2.5 miles per hr. x 1.47 = 3.9 ft./sec.	175	188	200	213
3.0 miles per hr. x 1.47 = 4.41 ft./sec.	210	225	240	255
3.5 miles per hr. x 1.47 = 5.15 ft./sec.	240	262	280	300
4.0 miles per hr. x 1.47 = 5.88 ft./sec.	280	300	320	340
4.5 miles per hr. x 1.47 = 6.68 ft./sec.	315	340	360	380
5.0 miles per hr. x 1.47 = 7.35 ft./sec.	350	375	400	425
	Pounds of anhydrous ammonia per hour for 30 pounds of nitrogen per acre			
2.0 miles per hr. x 1.47 = 2.94 ft./sec.	105	113	120	128
2.5 miles per hr. x 1.47 = 3.9 ft./sec.	130	140	150	160
3.0 miles per hr. x 1.47 = 4.41 ft./sec.	160	170	180	190
3.5 miles per hr. x 1.47 = 5.15 ft./sec.	180	195	210	220
4.0 miles per hr. x 1.47 = 5.88 ft./sec.	210	225	240	255
4.5 miles per hr. x 1.47 = 6.68 ft./sec.	240	255	270	285
5.0 miles per hr. x 1.47 = 7.35 ft./sec.	260	280	300	320

Determing the Setting of the Differential Pressure Valve

The equipment as used by the Mississippi Experiment Station has a manifold with 3/32-inch orifices which distribute the ammonia to the individual rows. The rate at which ammonia flows through orifice depends upon the tank pressure. After the rate of ammonia per hour has been determined, it is necessary to determine the pressure on which the regulating valve must be set to give the desired pounds of ammonia.

Table 13 shows the regulating valve pressure settings which are necessary to supply a given amount of ammonia per hour with different tank pressures. As an example, where 340 pounds of ammonia per hour is desired and the tank pressure is 115 pounds per square inch, the regulator valve should be set on 49 pounds pressure per square inch. For 2-row equipment the reading is obtained for twice the desired amount of ammonia. If 170 pounds of ammonia were required for 2-row equipment, the valve setting would be for 340 pounds per hour as shown in the table.

It is recommended that manufacturers of equipment obtain a rotameter and calibrate the equipment which they build. The size of the orifices and the pressure shown by the regulating valve determine the rate of flow of ammonia.

Equipment for Storing and Applying Aqua Ammonia

Aqua ammonia (30 percent ammonia) exerts no pressure below 70 degrees Fahrenheit. At 110 degrees Fahrenheit a pressure of 10 pounds per square inch is exerted. In order to avoid the loss of ammonia from aqua ammonia it should be maintained in a closed system at all times. Where tanks have openings into the air some ammonia will be lost constantly.

All tanks for handling aqua ammonia should have the following fittings:

1. Filling valve.
2. Pop-off valve set on 10 pounds pressure.
3. Bleeding valve.
4. Air inlet check valve.
5. Outlet valve and hose.
6. Glass indicator gauge.

All fittings should be made of iron

Table 13. Pressure setting for the differential pressure regulating valve; 4-row equipment 3/32" orifices in each line.[1]

Pounds per hour		Tank pressure—pounds						
Anhydrous ammonia	Nitrogen	70	90	115	125	150	170	190
		Regulator valve gauge reading in pounds						
400	333	43	50	59	65	71	74	80
380	311	41	48	56	62	67	71	76
360	295	39	45	53	59	64	67	72
340	278	36	42	49	55	60	63	67
320	262	34	40	46	52	56	59	63
300	246	32	37	43	48	52	55	59
280	230	30	34	40	45	49	51	55
260	213	28	32	37	42	45	48	51
240	197	25	29	34	38	41	44	47
220	180	23	26	31	35	38	40	42
200	164	21	23	28	32	34	36	38
180	148	19	21	24	28	30	32	34
160	131	16	18	21	24	26	28	30
140	115	14	16	18	21	23	24	26
120	98	12	13	15	17	19	20	22
100	92	9	10	12	14	15	16	17

[1] Manifold built of ¼" x 2" nipples, tees and elbows.

or steel. Copper or brass fittings are not suitable.

All tanks and fittings should be tested for a working pressure of 30 pounds per square inch. Where 30 percent aqua ammonia is used, normally the highest anticipated pressure is 10 pounds per square inch, but where tanks are not shaded the pressure may go higher in the summer and the above tank specifications are suggested to cover extremes.

The material handled in this equipment normally has no pressure. This makes it possible to use a low pressure metering pump to meter the material to the applicators. The type of pump used is a 20 DV Yale-Towne rotary positive deplacement pump with variable volume manual control that will give a maximum 1.5 gallons per hundred revolutions.

The pump is driven from the tractor axle through a counter shaft which steps the speed up to 400 R.P.M. A 1¼-inch liquid line connects the pump to the tractor tank on the suction side of the pump. Then, there should be a 5- to 10-pound pressure relief discharge valve. The valve is used to cut off the small flow of liquid through the pump when the tractor is standing still. Connected to the pressure relief valve is the manifold built from ¼-inch x 2-inch pipe nipple, with 3/32-inch orifices installed into ¼-inch ammonia flange unions. The top of the cap of the union is turned out ¼-inch deeper to take the orifice, and the other side is threaded so that the orifice may be screwed into it. The ¼-inch 150-test rubber hose connects the manifold to the same type of applicator as described above, and disc hillers are used for covering when the equipment is mounted on the tractor with the cultivator.

The size of orifices would have to change for different hook ups as shown above.

When a metering pump has been developed to operate under high pressure ammonia, and suitable for mounting on a tractor, anhydrous ammonia may be applied in a manner similar to that described above for aqua ammonia.

The one great advantage of the metering pump is that the rate of distribution is timed with ground speed of the tractor.

A hose pump was developed for the application of aqua ammonia by the Ten-

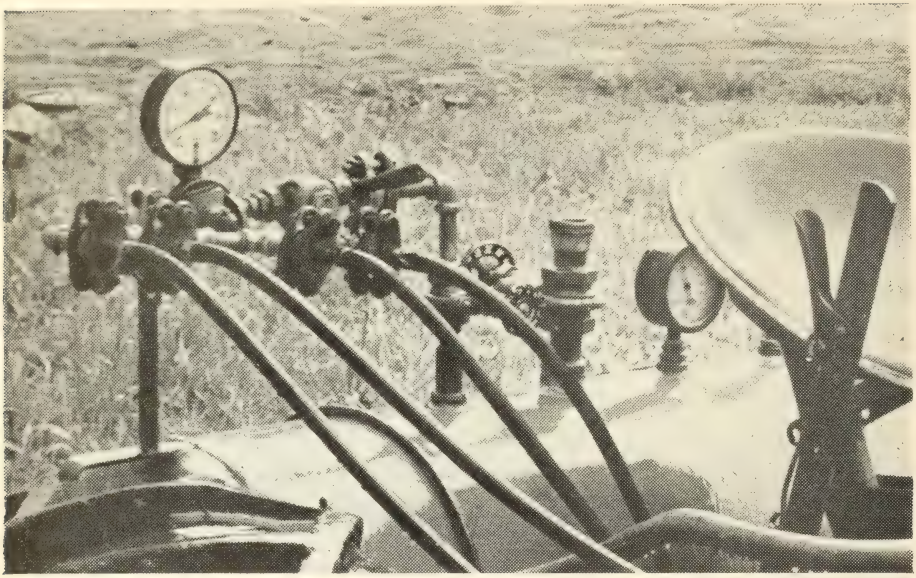

Figure 10. Fittings on tractor tank for applying anhydrous ammonia.

nessee Agricultural Experiment Station as reported in Circular 87. The pump consists of heavy walled rubber tubing, size ¼ to ½ inch, mounted over rollers, spaced 2 inches from the shaft which are driven by a chain or belt. The revolutions of the pump vary up to 200 per minute.

The quantity of aqua ammonia delivered per 100 revolutions by hose of different size is:

Inside diameter of tube in inches	Gallons per 100 revolutions
1/4	0.16
5/16	0.20
3/8	0.31
1/2	0.56

The quantity of ammonia delivered is varied by varying (a) the size of the sprocket wheels or drive pulleys, (b) the number of hoses for the width covered, and (c) the size of the hoses.

Since aqua ammonia should be maintained in a closed system to avoid the loss of ammonia, the field tanks should have a valve which admits air when pressure is lowered as the aqua ammonia is pumped out of the tank. It was advised in Tennessee Agricultural Experiment Station Circular 87, that aqua ammonia be diluted with water to avoid pressure when the temperature is above 80 degrees Fahrenheit.

If the increase in pressure above this temperature interferes with the operation of the pump it is necessary to operate it at atmospheric pressure and ammonia will escape through the gas outlet in the tank. Evidently, information is needed on this detail of the pump.

Several farmers have used the hose pump satisfactorily, presumably at atmospheric pressure. If this pump does handle the pressure developed by aqua ammonia, it has a very definite advantage in that sizes may be made which are suitable for one-horse as well as tractor equipment.

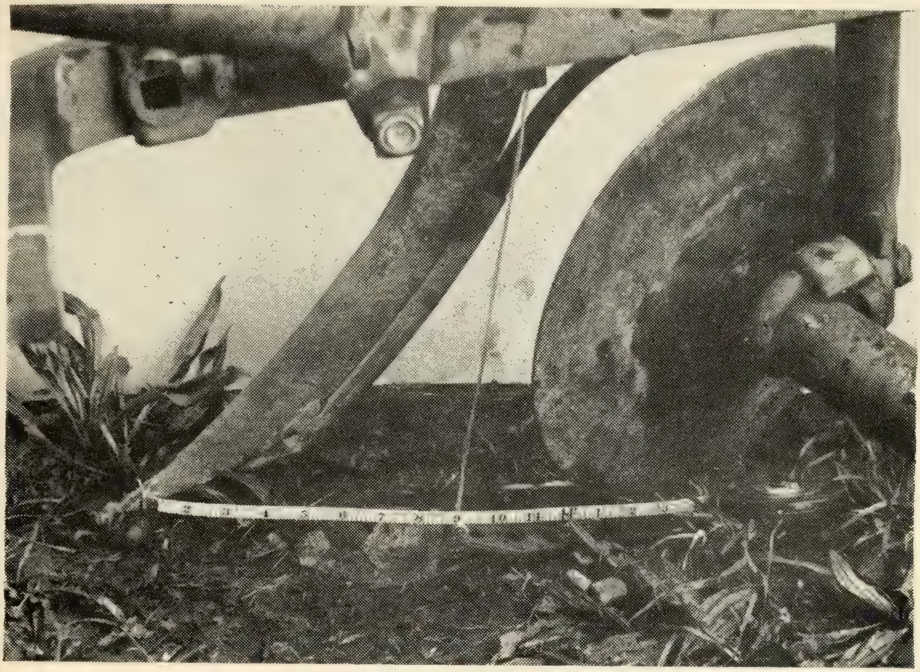

Figure 11. Applicator with rubber hose enclosed in iron pipe and disc hiller for covering. Note angle of knife, and flat suction point.

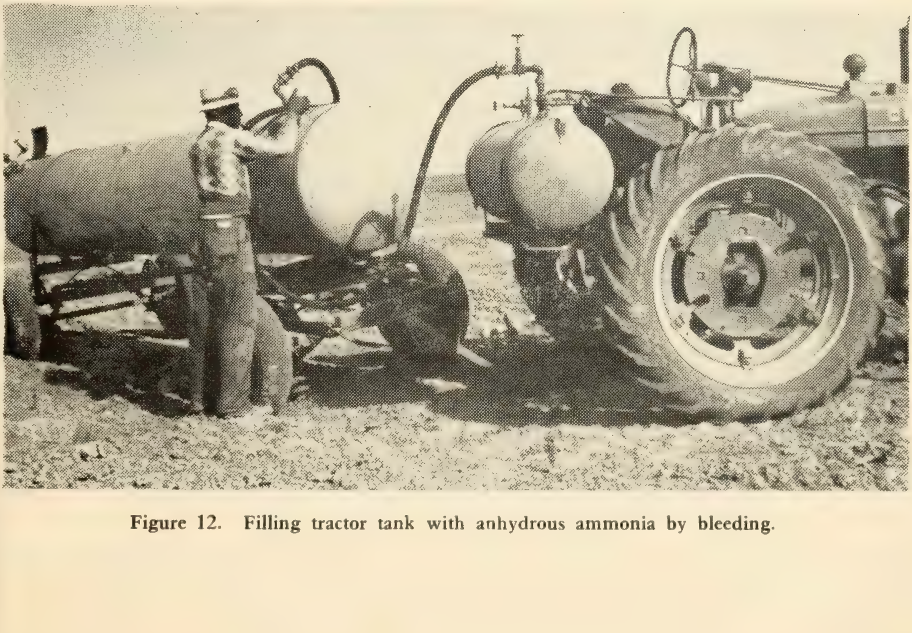

Figure 12. Filling tractor tank with anhydrous ammonia by bleeding.

MISS. EXPERIMENT STATION [illegible]
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Preparation of Vegetables In Small Town Families Of Mississippi

By

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AGRICULTURAL EXPERIMENT STATION
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Preparation of Vegetables in Small Town Families of Mississippi

By DOROTHY DICKINS

This study reports methods used in preparation of 9,246 cooked vegetables and vegetable salads by 844 families in six small towns of Mississippi. Methods used in preparation of vegetables are important, since vegetables are an excellent source of vitamins and minerals. Vitamins can easily be destroyed by poor methods of preparation and storage. Minerals can be lost by draining during cooking or after cooking is complete.

Methods of preparation in use will be compared with methods recommended by food and/or nutrition specialists. Suggestions for improving vegetable preparation will be given.

Methods and Scope of Study

Two methods of securing information concerning vegetable preparation were used in this study (1) the record method, whereby detailed day-by-day records of steps in preparation of particular vegetables served during the report week were kept by homemakers; (2) the schedule method, whereby homemakers were interviewed with the use of schedules concerning preparation of vegetables.

Both record and schedule methods were used in securing preparation information since somewhat more accurate information concerning preparation can be obtained by the record method, but families willing to keep detailed day-by-day preparation records have superior practices.[1] The schedule method, in addition to giving a more representative sample, has the further advantage of being less expensive. A large coverage of families is important in securing information about preparation of particular vegetables, since there are many vegetables used by only a few families.

The information of this study was secured from three sources: (1) from records kept one week by homemakers in 80 white and 80 Negro families in Ackerman, Eupora, and Marks. The families were representative of the main groups in which families in the survey study from which they were drawn had been classified.[2] (2) From schedules filled out by personal interview with homemakers in 145 white and 121 Negro families in Ackerman, Eupora, Marks, and Tunica. The families included constituted a random sample of families in the survey towns not in the record study. (3) From schedules filled out by personal interview with homemakers in all eligible families (295 white and 123 Negro) in Calhoun City and Friars Point. To be eligible for all of these studies, the family must have been a housekeeping family with a female homemaker and no more than one boarder.

The two schedule studies were limited in the main to preparation of vegetables for which no preparation records, or only a few preparation records, had been kept in the record study. There were a few exceptions, since it seemed desirable to compare preparation practices when the two methods of getting information were used. Information concerning preparation of new string beans, cabbage, and Irish potatoes, as well as preparation of string beans, cabbage, and Irish potatoes, was asked for, since in the survey mentioned above, a number of homemakers reported preparation rules concerning

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[1] See "Some Factors Related to Food Preparation," Dorothy Dickins, Miss. Agr. Exp. Sta. Bul. No. 433, p. 6.

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[2] For a discussion of the survey study, see "Changing Pattern of Food Preparation of Small Town Families of Mississippi," and "Traditional Food Preparation Rules," Bulletins 415 and 418 of Miss. Agr. Exp. Sta., by Dorothy Dickins.

"new" vegetables (the first mess or messes), especially new Irish potatoes. Information secured was limited to vegetables ordinarily served by the family when in season.

Forms used in the record and schedule studies are shown in the Appendix.

Description of Families

Median size of families in this study was three members. It was the same for Negro as for white families. Homemakers in white families had completed a median of 12 grades; in Negro families, a median of 6 grades. (By median is meant that there were as many families with more than three members as with less than three members; as many white homemakers with less than 12 grades of schooling as with more than 12 grades of schooling. The median is the midpoint.)

The main occupation of 374 of the 844 families included was unskilled, semiskilled, and skilled wage work in nonagricultural pursuits. In 145 families, the main occupation was white collar work; in 130 families, professional work or operation of independent businesses. One hundred and eight families were farmers (owners, renters, croppers or wage workers). Eighty-seven families had no occupation, but were living from dependency allotments, pensions, relief and/or investments.

The main occupation of relatively two times more Negro than white families was wage work and farming. The occupation of white families was much more often white collar work, professional work, and business ownership. Only 17 of the 324 Negro families included had these as main occupations. About the same proportion of Negro as of white families had no occupation—11 percent as compared with 9 percent.

Five hundred and fifty-four of the 844 families resided in houses with monthly rent or rental values of $20.00 or less, 254 in houses with monthly rent or rental values of $20.01 to $40.00, and 36 in houses of over $40.00. All Negro families resided in houses with a monthly rent or rental value of $20.00 and under.

Families in the record and schedule samples differed in certain respects. The main occupation of families in the record sample was somewhat more likely to be professional work or business ownership, somewhat less likely to be wage work (table 1 in Appendix). Homemakers in the record sample in families with rent or rental value the same, were younger than those in the schedule sample. Record-keeping Negro homemakers had completed a median of 8 grades as compared with 5 grades for non-record keepers. There was no difference in the median grade completed by white homemakers in the record and schedule samples.

Who Prepared and Source of Methods Used

Information as to who prepared and source of the methods in use were secured from homemakers in the record study. Eighty-nine percent of the vegetable dishes for which preparation records were kept were prepared by the homemaker.

Methods used in preparation of 70 percent of the cooked vegetable dishes were reported as those taught by mother. The source of the method used in about 10 percent of the cooked vegetables was stated as unknown. In about 5 percent it was said to be original.

In a previous study of this series in which 1,158 homemakers had been questioned about new vegetable dishes tried during the past year and source of recipe, friends were the source most often mentioned.[3] However, in the record study, homemakers were asked to keep records of dishes ordinarily prepared, when the food was in season, and most of the preparation records were of boiled string beans, butter beans, field peas, and Irish potatoes or vegetable dishes prepared in homes of parents and grandparents of these homemakers. The fact that cooked vegetable dishes for which records were kept were traditional dishes would account for the large number being reported as learned from mother.

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[3] "Changing Pattern of Food Preparation of Small Town Families of Mississippi," Dorothy Dickins, Miss. Agr. Exp. Sta. Bul. 415, p. 10.

Source of the recipes for raw vegetable dishes (vegetable salads) most often mentioned was original (or made it up). Mother was not so often the source of information as for cooked vegetables.

Methods of Preparing Vegetables

Ninety-three percent of the reports with which this bulletin is concerned are reports of cooked vegetable dishes. Seven percent are reports of raw vegetable dishes. (See table 2 in Appendix). Three-fourths of the reports of cooked vegetable dishes are reports of cooked fresh vegetables. The majority of families in the six towns included in this study produced most of their vegetable supply in the summer and some of it in winter. The fact that a number of families produce their vegetables would account for the large number of fresh vegetable reports secured.

Cooked Vegetable Dishes

Fresh Leafy Vegetables

Preparation reports of 11 different leafy vegetables were secured: beet tops, cabbage, Swiss chard, collards, kale, leaf lettuce, mustard greens, rape, spinach, tender greens, and turnip greens. (See table 2 in Appendix.) In all, 1,932 reports were obtained. Only 94 of these were from the record study. The record study was made in summer when fresh leafy vegetables were not usually available in home gardens, or if available, were not at their best eating stage. Fifty of the 94 records were of cooked cabbage, 23 of cooked turnip greens, and 14 of cooked collards.

The majority of leafy vegetables used by the families were reported as usually home produced. One exception was cabbage. About 50 percent in both the record and schedule groups reported that they purchased cabbage.

The usual procedure followed was to wash leafy vegetables several times in cold water. However, collard, turnip, and mustard greens were rather frequently washed in soda water by Negro women. About one-third of the Negro women interviewed in the schedule study reported that they washed collard greens in soda water; one-seventh reported they washed turnip greens in soda water, and one-tenth that they washed mustard greens in soda water.

Homemakers in both schedule studies were questioned about practices concerning use of stems and midribs of greens. Seventy-six percent said they discarded all stems. Forty-eight percent of the homemakers said they stripped the center (removed the midrib) when greens were old and tough, and 4 percent that they stripped the center always.

About 10 percent of the leafy vegetables were soaked before cooking, usually in cool water. This practice was much more common in case of collard and cabbage than other greens. Soda was added to the soaking water by a few—more often by Negro than white women and in preparation of collards than in other greens. Nearly 10 percent of the Negro homemakers in the schedule study added soda to the water when soaking collard greens. In only one of the collard preparation records kept by a Negro woman, the greens were soaked in soda water before cooking.

Greens were more often started to cook in a kettle with boiling water and partly cooked salt pork than by any other method. About two-thirds reported that collards, turnip greens, tender greens, and kale were thus started; about one-half cabbage, mustard and rape; one-third, beet tops and Swiss chard; and one fifth, spinach.

The typical method of preparing spinach was to start in a small amount of boiling water, cook until tender and drain. This was also the method followed by the majority reporting preparation of beet tops and Swiss chard. Families using salt pork in cooking these three leafy vegetables as well as in cooking kale, rape, and mustard, often mixed and cooked along with turnip greens. Collards and turnip greens were the leafy vegetables most often started in cold water with raw salt pork. About 20 percent reporting on those two vegetables stated that this was the usual method.

Butter or oleo was used by the most families in seasoning spinach and by the fewest families in seasoning collards. In fact, no homemaker reported butter or oleo as the usual seasoning added to collard greens. Only two or three reported these fats ordinarily used in seasoning turnip, mustard, and tender greens. Salt pork or bacon grease and lard were used by a number of homemakers. Sometimes these fats were used along with salt pork "to make the pork go further."

About one-half of the women reported that they tore up or stripped large leaves before cooking. Small leaves were generally cooked whole. About one third quartered cabbage, and the remainder cut it in small pieces before cooking.

Five or more homemakers reported ordinarily adding soda in cooking of cabbage, collards, kale, mustard, rape, tender greens, and turnip greens. Seventeen percent reported adding soda during cooking of collard greens, 10 percent during cooking of turnip greens, and 8 percent during cooking of cabbage. Only 3 percent reporting on tender greens said they usually added soda during cooking. The practice of adding soda during cooking was much more common in the Negro than in the white household. For example, only two of the 36 adding soda to collards during cooking were white women; only one of the 29 adding soda to turnip greens was a white woman.

Parboiling leafy vegetables, that is, cooking a few minutes, then draining, adding more water and continuing cooking, was most common for spinach. About 14 percent reported parboiling. Cabbage, turnip greens, and mustard greens were other vegetables usually parboiled by a few homemakers. Parboiling was a practice more common in the white than in the Negro group.

In the two schedule studies homemakers were asked whether they cooked vegetables with lid off or on, and cabbage was the only vegetable mentioned as being cooked with lid off.

In both schedule studies homemakers were asked if they started vegetables in no water, a little water, one-half covered, covered, or more than covered. The majority replied in a little water for all vegetables about which questioned, except new Irish potatoes, beets, and collards. The first two were most often reported as started as covered; collards as started one-half covered. The practice was to add water during cooking, rather than to begin with large amounts.

Record keeping homemakers also used only a little water in starting vegetables. Data concerning total amounts used by this group were not satisfactory, since many forgot to record amounts added during cooking. For this reason, these data were not summarized.

A few homemakers added sugar to all vegetables which they prepared. A number added it in preparation of particular vegetables only. From 30 to 40 percent added sugar to turnip greens, rape, collards, mustard greens, and kale (40 percent to turnip greens and 30 percent to kale.) Nineteen percent added sugar in preparation of cabbage, 15 percent in preparation of chard, and 11 percent in preparation of tender greens. Less than 10 percent used sugar in preparation of spinach and beet tops.

Homemakers varied considerably as to time of adding salt. About one-third added salt at the time of putting the vegetable on to cook, a little less than one-third added it during the cooking process and a little more than one-third at the end of the cooking period. The proportion following the various practices as to adding salt was about the same for all greens.

In testing the forms to be used in the schedule studies, it was found that homemakers seemed to give more accurate information concerning the usual hour of putting vegetables on the stove and the usual hour of serving the meal. Therefore, this information was asked for in the schedule studies rather than: How long do you cook turnip greens, mustard greens? Time between cooking and serving the meal was worked out for each vegetable when editing the schedule.

Median, minimum and maximum time between putting on to cook and serving reported for the different leafy vegetables by homemakers in the two schedule studies is given in table 1. In the interval between completing cooking and serving most homemakers kept the vegetable on a cooler part of the stove, or in the warming oven. However, a few dished it up and placed it on the dining table. Some homemakers arranged cooking time so there was no interval between completing cooking and serving. In the record studies in which a record was kept of time from putting on range to completing cooking and of time between completing cooking and serving, in about one-third of the records of leafy vegetables there was no interval.

As will be noted in table 1, collards turnip greens, kale, mustard, rape, tender greens, and cabbage were the leafy vegetables which had the longest cooking and standing periods. These were also the leafy vegetables most often seasoned with salt pork. Median time between putting on to cook and serving was less for vegetables not seasoned with salt pork than for vegetables seasoned with salt pork. For example, the median interval for spinach when seasoned with salt pork was two hours; when not seasoned with salt pork, 30 minutes.

There was wide variation in minimum

Table 1. Median, minimum, and maximum time between putting different leafy vegetables on the stove and serving as reported by homemakers in schedule studies. Median, minimum, and maximum cooking time and time between completed cooking and serving different leafy vegetables as recorded by homemakers in record study.

	Schedule studies			Record study					
	Time between putting on to cook and serving			Time between putting on to cook and completing cooking			Time between completing cooking and serving		
Vegetable	Median	Min.	Max.	Median	Min.	Max.	Median	Min.	Max.
	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes
Beet tops	40	15	160	0	0	0	0	0	0
Cabbage	75	30	210	40	15	130	20	0	90
New cabbage	60	30	180	0	0	0	0	0	0
Chard, Swiss	45	20	160	30*	15*	45*	25*	20*	30*
Collards	120	60	210	90	60	170	30	0	110
Kale	90	30	180	0	0	0	0	0	0
Mustard	90	30	210	60	**	**	25	**	**
Lettuce	30	**	**	0	0	0	0	0	0
Rape	90	30	210	0	0	0	0	0	0
Spinach	45	15	150	20*	15*	30*	20*	0*	60*
Tender greens	90	30	180	0	0	0	0	0	0
Turnip greens	120	60	210	80	45	135	30	0	105

*Two to nine records.

**One record.

and maximum time between putting the vegetable on the range to cook and serving (table 1). The variation was less in case of collards and turnip greens, the two vegetables in which minimum time was greatest.

Most homemakers reported that they either had no pot liquor or that the liquor they had was consumed by the family. Only 10 percent of the leafy vegetable records showed pot liquor not consumed. Pot liquor from beet tops, kale, rape, and spinach was the kind of pot liquor most frequently reported not eaten; while pot liquor from cabbage, turnip greens, and mustard greens was the pot liquor least frequently reported as not eaten. Pot liquor is the liquid seasoned with fat on the vegetable at the time of serving.

Negro homemakers in the record study kept records, with the help of a Negro supervisor, of 43 cookings or lots of cabbage cooked. Information concerning the usual method of cooking cabbage was obtained from 110 Negro homemakers in the schedule study. Data are, therefore, available for comparing the practices of the record and schedule groups.

In 10 percent of the preparation records of Negro homemakers, cabbage was soaked in cold water before cooking; in 2 percent it was soaked in cold soda water. Twenty-one percent of the Negro homemakers in the schedule group reported that cabbage was soaked before it was cooked; 6 percent reported it soaked in cold soda water.

In none of the cabbage preparation records of Negro homemakers was the cabbage parboiled, but 8 percent of the Negro homemakers in the schedule group reported parboiling cabbage one time. About 10 percent of the cabbage preparation records kept by Negro homemakers showed soda added during cooking. About one-fourth of the Negro homemakers in the schedule study reported using soda in cooking cabbage.

Negro women in the schedule study reported an interval of one and one-half hours (median time) from the time of putting cabbage on the stove to serving it. Cabbage preparation records kept by Negro women showed a median time of 45 minutes from putting on the range to completing cooking. In 70 percent of these records, there was an interval of 30 minutes (median time) from time of completing cooking to serving.

The leafy vegetable reports also permit comparison of preparation of cabbage and new cabbage. There was little if any difference in preparation methods used in preparing mature and young cabbage. Whatever difference there was could be attributed to more white families, fewer Negro families in the new cabbage group; more Negro families, fewer white families in the cabbage group.

Fresh Legumes

Preparation reports of four different fresh legumes were secured: butter beans, (lima beans) string beans (shelled), English peas, field peas (cow peas) and mixtures of the same. (See table 2 in the Appendix.) Five hundred and sixty-seven reports were obtained; 275 were from the record study. The record study was made in the summer when butter beans, string beans, and field peas were in season.

In both schedule studies, all 684 homemakers were asked three questions (based on findings of record studies) about shelling green butter beans and field peas ahead: (1) Are green butter beans and peas shelled more than one-half hour before cooking: often_____ sometimes_____ never_____? (2) Are green butter beans and peas purchased shelled: often_____ sometimes_____ never_____? (3) If purchased shelled or if shelled ahead, where are they kept before cooking: refrigerator_____ table in kitchen_____ window_____ back porch_____ in pan of cool water_____?

Forty-five percent stated that they never shelled beans and peas more than one-

Table 2. Median, minimum, and maximum time between putting different fresh legumes on the stove and serving, as reported by homemakers in schedule studies. Median, minimum, and maximum cooking time and time between completed cooking and serving different fresh legumes, as recorded by homemakers in record study.

Vegetable	Schedule studies			Record study					
	Time between putting on to cook and serving			Time between putting on to cook and completing cooking			Time between completing cooking and serving		
	Median	Min.	Max.	Median	Min.	Max.	Median	Min.	Max.
	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes
Beans, butter	0	0	0	70	15	135	30	0	120
Beans, string, shelled	0	0	0	*105	*90	*120	*30	*20	*40
Beans, butter, and string beans mixed	0	0	0	*95	*70	*120	*25	*20	*30
Peas, English	60	30	180	0	0	0	0	0	0
Peas, field	0	0	0	90	30	150	30	0	100
Field peas and butter beans, mixed	0	0	0	*85	*60	*110	*20	*10	*30

*Two to nine records.
**One record.

half hour before cooking, 28 percent stated that they seldom did, and 27 percent that they often did. Seventy-six percent stated that they never purchased beans and peas already shelled. Twenty percent said they did sometimes, and 4 percent that they did often. Seventy percent of those shelling beans and peas ahead or purchasing them shelled kept these vegetables in the refrigerator until cooking time, 22 percent kept them on the table in the kitchen, and the remainder in a window, on the back porch, or in a pan of cool water. Only two homemakers reported using a pan of cool water.

The typical pattern followed by homemakers in the record study was to shell beans and peas shortly before cooking. However, about 8 percent of the cookings or lots for which preparation records were kept were shelled ahead. This practice was more common in the group of families in which there were young children. The supply of fresh legumes used by most homemakers was home produced.

Soaking shelled peas and beans in water before cooking was somewhat less common in the case of legumes than of leafy vegetables. In a little less than one-tenth of the legume preparation records, soaking was reported. It was reported three times more frequently by Negro than white women. No homemaker said that fresh legumes were soaked in soda water.

In about three-fourths of the preparation reports for English peas, butter beans, and field peas the vegetable was started in cold water. In the preparation of butter beans and field peas, one or more thin slices of salt pork or bacon were usually added at the beginning. However, butter or oleo was the most common seasoning used for English peas. About one-half of the homemakers reported seasoning English peas with butter or oleo. One-fourth of the lots of butter beans for which records were kept were seasoned with butter or oleo. Only four of the 124 lots of field peas were seasoned with butter or oleo. In 114 of the 292 reports on English peas and in 2 of the 145 records on butter beans, milk, white sauce or cream was used.

Only five homemakers reported addition of soda during cooking of fresh legumes. None reported parboiling them.

About one-third of the homemakers reported addition of sugar to English peas. In about one-fifth of the butter bean records and one-tenth of the field pea records it was added. In about one-half of the legume reports salt was not added until the beans or peas were tender. One-third reported salt added at the time of putting the legume on the range.

In table 2 is given median, minimum, and maximum time between putting on to cook and serving, time between putting on the range and completing cooking, and time between completing cooking and serving of the fresh legumes for which preparation information was secured. As will be noted median interval between putting on range and serving was greater for field peas than for butter beans and English peas. Field peas was the legume most often seasoned with salt pork; English peas, the least often seasoned with salt pork. As in the case of leafy vegetables, there was great variation in cooking time.

Two-thirds of the lots of butter beans and field peas for which records were kept had an interval between completing cooking and serving. About 80 percent of each of these lots of vegetables were held on the back of the stove; about 17 percent, on the dining table; and the remainder, in the warmer of the range.

Very few homemakers reported pot liquor from legumes not eaten. About one in ten of the butter bean and field pea records showed pot liquor not eaten. Only 5 percent of the homemakers reporting on preparation of English peas stated that there was generally pot liquor which family members did not consume.

In relatively more of the white record-keeping families residing in houses of higher rent or rental value, there was no interval between completing cooking and serving beans and peas. Negro homemakers more often cooked beans and peas ahead than white families with the same rent or rental value.

Ninety-four women kept one preparation record of butter beans. Eighteen kept two preparation records and five women kept three preparation records.[4] One lot of beans was rarely prepared just exactly as another, but there was much more variation in usual methods used by different women than in methods used in these different cookings by any one woman. A homemaker who started butter beans in cold water one morning usually started them in cold water another morning. One who completed cooking butter beans well before serving time on Tuesday usually completed cooking them well before serving time on Friday.

Roots and Tubers

Preparation reports of seven different roots and tubers were obtained: beets, carrots, onions, Irish potatoes, sweet potatoes, rutabagas, and turnips. (See table 2 in the Appendix.)

In all of the 2,032 reports obtained, only 175 were from the record study. Seventy-eight percent of the 175 were records of Irish potatoes. At the time of the study, Irish potatoes were in season, but not sweet potatoes. The supply of sweet potatoes from the previous season had been used up and the new supply was not available, except in very limited amounts.

Most of the homemakers giving reports on preparation of beets, onions, turnips, new Irish potatoes, and carrots stated that the supply was home produced. Forty-seven percent of the lots of Irish potatoes from the record study were home produced. The study was made after the home produced supply of many families was exhausted. Bliss Triumph is the most common variety of Irish potato grown in Mississippi. It is popular because it is an early potato and because gardeners are accustomed to growing a red variety. However, it does not keep so well. For this reason, many gardeners produce only a limited supply. About one-third of the homemakers reported producing most of their supply of sweet potatoes. Only two homemakers reported rutabagas were home produced. Rutabagas are less suitable for Mississippi climatic conditions than are many other vegetables and are, hence, seldom produced.

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[4] Cooperators were asked not to turn in any more than three preparation records for any one food served during the report week.

Roots and tubers were generally scraped, peeled, or skinned before cooking, except for beets and sweet potatoes. Baking was the method of preparation reported by 60 percent of the homemakers giving preparation information about sweet potatoes. Soaking of roots and tubers before cooking was not a common practice except for Irish potatoes. About one-fifth of the homemakers interviewed about new Irish potatoes reported soaking them in water before cooking. In 14 percent of the Irish potato records turned in, the potatoes were soaked before cooking.

Homemakers varied considerably as to the practice of cooking roots and tubers whole or in pieces. Beets were always cooked whole, and all homemakers except 4 percent reported new Irish potatoes cooked whole. Carrots, turnips and rutabagas were almost always cut up before cooking. About three-fourths of the lots of mature Irish potatoes of which preparation records were kept were sliced or cut up before cooking. About one-third of the homemakers reporting on onions and sweet potatoes said these two vegetables were usually cut up before cooking.

Boiling was the method of cooking used in preparation of leafy vegetables and legumes, but other methods of cooking were most frequently used by a number of homemakers in cooking certain of the roots and tubers. Twenty-seven percent of the homemakers reported that frying was the most frequent method of cooking onions. Ten percent reported that sweet potatoes were most frequently fried. Of the records of Irish potatoes kept during the record study, 18 percent were of fried Irish potatoes. Four percent were of baked Irish potatoes. Fifty-seven percent of the women interviewed about preparation of sweet potatoes stated that baking was the most common method of preparation. Boiling was the method of cooking beets, carrots, new Irish potatoes, rutabagas, and turnips.

In about 90 percent of the boiled beets, new Irish potato, and onion reports, in 80 percent of the Irish potato reports, in nearly 70 percent of the carrot and sweet potato reports, and in 45 percent of the rutabaga and turnip reports, the vegetables were started in cold water.

Beets were always drained. New Irish potatoes were almost without exception drained. In about 60 percent of the boiled mature Irish potato reports and 33 percent of the boiled sweet potato reports, the potatoes were drained. Nearly 20 percent reported drainage of boiled onions before seasoning. Sixteen percent of the homemakers reporting on carrots said they drained the liquor. Turnips and rutabagas were rarely drained.

Boiled beets were most frequently seasoned with sugar and vinegar; onions, carrots, and new Irish potatoes with butter or oleo (about 40 percent of the homemakers reported that milk was added to new Irish potatoes). Boiled sweet potatoes were most frequently candied. Turnips and rutabagas were generally cooked with salt pork. About one-fourth of the lots of boiled mature potatoes for which records were kept were served as salad, one-fourth as stewed or boiled potatoes, and one-half as mashed potatoes. Mature potatoes were more often seasoned with grease than were new potatoes. However, the majority used butter or oleo for seasoning mature Irish potatoes. In 24 of the 53 lots of mashed potatoes, milk was added.

The practice of parboiling roots and tubers was rarely reported, except in the case of new Irish potatoes. Two hundred and fifty-two of the 400 families parboiled new Irish potatoes; 212 parboiled one time, 29 parboiled two times, and 11 parboiled more than two times. Only 72 of the 252 women parboiling new potatoes were Negro women. Nine white women and four Negro women added soda during parboiling. Ten of the 93 women reporting on preparation of rutabagas and three of the 315 reporting on preparation of turnips mentioned adding soda during cooking. Young turnips are usually cooked with turnip greens. It is only the more mature turnips that are cooked alone.

Salt was most often added to roots and tubers when tender or done, and least often during cooking. Thirty-five of the 183 women reporting on preparation of fried and boiled sweet potatoes stated that they did not use salt. One hundred and forty-nine of the 349 reporting on preparation of beets stated that they did not use salt. These were women giving a record of preparation for pickled beets.

Ninety percent of the homemakers reported using sugar in preparation of beets; 40 percent in preparation of sweet potatoes; 20 percent in preparation of carrots; 15 percent in preparation of turnips; and 14 percent in preparation of rutabagas. It was used by less than 10 percent of the women in preparation of onions and Irish potatoes.

As will be noted in table 3, time between putting roots and tubers on the range and serving, between putting on to cook and completing cooking and between completing cooking and serving varied greatly for any particular vegetable.

Table 3. Median, minimum, and maximum time between putting different roots and tubers on the stove and serving as reported by homemakers in schedule studies. Median, minimum, and maximum preparation time and time between completed preparation and serving different roots and tubers as recorded by homemakers in record study.

Vegetables	Schedule studies			Record study					
	Time between putting on to cook and serving			Time between putting on to cook and completing preparation			Time between completing preparation and serving		
	Median	Min.	Max.	Median	Min.	Max.	Median	Min.	Max.
	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes
Beets	150	60	245	65	45	90	70	0	120
Carrots	60	30	150	30	15	90	30	0	45
Onions:									
Fried	30	20	60	20	**	**	10	**	**
Boiled	60	25	120	40*	20*	55*	20*	0*	45*
Potatoes:									
Baked	0	0	0	60*	45*	75*	15*	0*	30*
Fried	0	0	0	20	10	30	20	0	60
Boiled	0	0	0	45	20	75	30	0	75
Potatoes, Irish and butter beans	0	0	0	70	**	**	20	**	**
Potatoes, Irish and string beans	0	0	0	90	**	**	0	**	**
Potatoes, Irish new	90	60	150	0	0	0	0	0	0
Potatoes, sweet:									
Baked	75	45	120	0	0	0	0	0	0
Fried	45	30	90	20	**	**	10	**	**
Boiled***	75	45	100	45	30	80	30	0	80
Rutabagas	120	30	210	30	**	**	0	**	**
Turnips	100	30	180	30	**	**	0	**	**

*Two to nine records.

**One record.

***Including a few candied in the oven.

The period between putting on to cook and serving was greatest for beets, but most of the beets were served cold, as pickled beets. They were prepared well in advance of the time to serve. Families reporting on buttered beets (38 so reported) had a shorter interval between beginning cooking and serving. Median time was 1½ hours.

Median cooking time (time from putting on stove to completing cooking) was 35 minutes for cut up potatoes; 50 minutes for whole Irish potatoes. About two-thirds of the Irish potato records showed a holding period; that is, an interval between completing preparation and serving.

At the time of making this study, the pressure sauce pan was not available. A number of families owned steam pressure canners, but these were not ordinarily used for cooking vegetables.

Discarding pot liquor from roots and tubers was uncommon. In about 6 percent of the onion and carrot preparation records, pot liquor not consumed was reported. In the other vegetables of this group, less than 1 percent reported pot liquor left. Draining of roots and tubers before adding seasoning was common, especially in certain of the vegetables, and for this reason, there would be in many cases no liquor to consume.

Other Fresh Vegetables

Preparation reports of nine other fresh vegetables were obtained: string beans, cauliflower, corn, eggplant, okra, green pepper, summer squash, tomato, and vegetable mixture (three or more fresh vegetables). In all, 1,849 reports were secured. Two hundred and eighty-one of these were from the record study; the remainder from the two schedule studies.

From 66 to 88 percent of the homemakers reporting on eight of the nine vegetables stated that the supply was usually home produced. The ninth vegetable—cauliflower—was purchased by those using it. Cauliflower is not generally grown in Mississippi.

In preparation for cooking, string beans were broken into small pieces (no homemaker reported shredding string beans. Only 11 reported cooking them whole, and 10 of these were reports of "new" string beans). Thirteen of the 24 records on cauliflower stated that cauliflower was cooked whole; 11, that it was broken into flowerets. Seventeen percent of the corn reports showed it cooked on the cob, 83 percent cut and scraped from the cob. Eggplant, squash, tomato and vegetable mixture were cut up or sliced before cooking. Okra was usually boiled whole.

Soaking in water before cooking was a practice rarely followed, except in preparing cauliflower and eggplant. One-fourth of those reporting on cauliflower and nearly one half of those reporting on eggplant said they soaked the vegetable before cooking. Eggplant to be fried was generally sliced and soaked in cool water, usually salt water, before cooking.

As in the case of roots and tubers, frying was the method of cooking most often used by some of the homemakers for certain of these other vegetables. Eighty-four percent of those reporting on eggplant stated that frying was the most common method. Proportions reporting frying as the usual method of preparation of other vegetables in this group were: 33 percent okra, 7 percent tomatoes (green tomatoes), and 7 percent corn. Homemakers cooking corn with lard or bacon or salt pork grease and adding no liquid were classified as frying corn.

The sliced eggplant was dipped in flour, cornmeal, or a batter of flour, eggs, and milk, before frying. Twenty-seven of the 132 homemakers reported that eggplant was usually first boiled, then drained, mashed, salt and flour added, and the eggplant batter resulting fried.

Okra was generally dipped in cornmeal; green tomatoes in either flour or cornmeal before frying.

String beans, cauliflower, corn, squash, tomato, and vegetable mixture were generally started in a little cold water. In about one-half of the reports, okra was started in cold water; in the other half, in boiling water. In this latter group, there were a number in which the okra had been cooked on the top of boiling field peas.

String beans was the only vegetable in this group usually seasoned with salt pork. In about 85 percent of the string bean records, it was the fat used. Stewing was the usual method of preparation by 75 percent of those reporting on corn. Stewed corn was generally seasoned with bacon or salt pork grease. Only about 33 percent reported butter or oleo and 16 percent milk used. Squash was likewise usually seasoned with grease.

Cauliflower was seasoned with butter or oleo by one-half of the group and with white sauce by the other half. Okra, tomatoes, and vegetable mixture were seasoned with butter or oleo by the majority. In the 19 records of vegetable mixture and in 10 of the 21 records of fresh tomatoes, soup was made. This soup was generally prepared by adding a little water to the tomato or to the vegetable mixture, boiling, adding fat (generally butter or oleo), salt, pepper and oftentimes a little sugar. Spaghetti was reported as being added in several of the lots of tomato soup. In all of the vegetable mixtures except one, fresh tomatoes were used (canned tomatoes was used in this lot). In 13, butter beans were used; in 12, okra; in 10, corn; in 10, onion; in 9, potato. Other fresh vegetables found in not more than four of the records were carrots, peppers, and field peas.

The majority reporting on cauliflower drained it before adding butter, oleo, or white sauce. Other vegetables which were drained by about one-third reporting were okra, eggplant, and squash. Corn cooked on the cob was, of course, drained.

The practices of parboiling vegetables and of adding soda during cooking were limited in this group of other vegetables to preparation of string beans. About 1 percent of those reporting on string beans and 4 percent on new string beans reported parboiling. Six percent showed the use of soda in cooking string beans, and 9 percent in cooking new string beans.

Salt was more often added after the vegetable was tender in the preparation of string beans, cauliflower, and squash. In one-fifth of the string bean records, in one-third of the new string bean records, in about four-tenths of the corn records, and in one-third of the squash records, a little sugar was added. Sugar was also found in most of the preparation records of fresh tomatoes and of vegetable mixtures.

As will be noted in table 4, median interval between putting on the range and serving, for string beans, was greater than for the other vegetables listed. Cooking time was as great for scalloped eggplant as for new string beans, but the eggplant must be boiled first on the top of the stove and then baked in an oven after other ingredients, such as eggs, bread crumbs, onions, milk, were added.

There was great variation in time of preparing vegetables by different homemakers. For example, in the record study, one homemaker cooked string beans 20 minutes; another, 2 hours and 35 minutes. One homemaker cooked okra 15 minutes; another, 1½ hours.

In this study, 50 reports of string beans were obtained by the record method and 259 by the schedule method. Only one of the lots in the record study (2 percent) showed the use of soda in cooking string beans, while 7 percent of the reports in the schedule study showed the use of soda. Intervals between putting on the range and serving in the two groups were similar.

Table 4. Median, minimum, and maximum time between putting all other fresh vegetables on the stove and serving, as reported by homemakers in the schedule studies. Median, minimum, and maximum preparation time, and time between completed cooking and serving all other fresh vegetables, as recorded by homemakers in the record study.

Vegetable	Schedule studies			Record study					
	Time between putting on to cook and serving			Time between putting on to cook and completing cooking			Time between completing cooking and serving		
	Median	Min.	Max.	Median	Min.	Max.	Median	Min.	Max.
	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes
String beans	135	60	210	90	20	155	30	0	95
String bean, new	120	45	185	0	0	0	0	0	0
Cauliflower	45	30	60	30	**	**	10	**	**
Corn:									
Boiled	45	20	90	30	15	60	20	0	45
***stewed & fried	60	30	120	45	15	105	30	0	60
Eggplant:									
Fried	60	30	90	30*	10*	45*	15*	0*	45*
Scalloped	120	90	180	60*	45*	75*	15*	0*	30*
Okra:									
Fried	0	0	0	30	15	60	15	0	45
Boiled	0	0	0	30	15	90	30	0	90
Peppers:									
Baked	0	0	0	45	30	90	30	0	60
Squash	45	30	100	40	25	75	25	0	50
Tomato:									
Fried	0	0	0	20	15	30	15	0	30
Boiled****	0	0	0	45	30	120	20	0	50
Vegetable mixture	0	0	0	75	40	135	30	0	75

*Two to nine records.

**One record.

***Includes one corn pudding.

****Includes one baked tomato.

Practices in preparation of new string beans differed very little from practices in preparation of string beans.

Canned Vegetables

Preparation reports of 22 different canned vegetables were secured: butter beans, pork and beans, string beans, beets (roots), cabbage, carrots, Swiss chard, corn, eggplant, kraut, mustard, okra, English peas, field peas, sweet potatoes, spinach, squash, tomatoes, turnip greens, pumpkin, and vegetable mixtures (table 2 in Appendix). In all, 1,712 reports were obtained; only 60 of these were secured from the record study. The record study, as has been stated before, was made at a time when a plentiful supply of fresh vegetables was available in many of the home gardens. Twenty-four of the 60 records were preparation records of canned English peas.

As will be noted in table 5, the supply of canned asparagus, pork and beans, corn, English peas, sweet potatoes, and spinach was purchased by the majority of homemakers reporting for these vegetables. Those giving reports on canned string beans, beets, cabbage, carrots, kraut, mustard, field peas, squash, and vegetable mixture usually canned their supply at home (table 5).

Cabbage, kraut, and tomatoes were the vegetables in which one-third or more of the women reported ordinarily using the open kettle method. The water bath method was most frequently used by 50 percent or more of those reporting on home canning of string beans, cabbage, and vegetable mixtures; the steam pressure method by 50 percent or more of those reporting on home canning of corn, mustard, okra, squash, and turnip

Table 5. Proportion of canned vegetable preparation reports in which it was stated that canned vegetable usually purchased and proportion in which it was stated that canned vegetable home canned. Proportion of home canned vegetable ordinarily canned by various methods.

Vegetable	Number of records	Supply usually		Home canned vegetables usually canned by:			
		Purchased	Home canned	Open kettle method	Water bath method	Steam pressure canner	Oven
		Percent	Percent	Percent	Percent	Percent	Percent
Asparagus	26	100	0	0	0	0	0
Beans, butter	172	33	67	9	40	46	5
Beans, pork and	23	100	0	0	0	0	0
Beans, string	237	25	75	23	55	22	0
Beets, roots	19	5	95	33	45	22	0
Cabbage	11	0	100	36	54	10	0
Carrots	31	16	84	23	31	46	0
Chard, Swiss*	1	—	—	—	—	—	—
Corn	243	62	38	12	23	57	8
Eggplant**	8	—	—	—	—	—	—
Kraut	80	15	85	47	30	23	0
Mustard	15	0	100	20	20	60	0
Okra	71	4	96	12	37	51	0
Peas, English	238	86	14	10	42	48	0
Peas, field	106	12	88	12	38	46	0
Potatoes, sweet***	12	92	8	—	—	—	—
Spinach****	22	68	32	—	—	—	—
Squash	46	2	98	3	43	50	3
Tomatoes	252	30	70	45	45	10	0
Turnip greens	58	37	63	6	36	58	0
Pumpkin*****	1	—	—	—	—	—	—
Vegetable mixtures	40	16	84	9	56	35	0

*Home canned, steam pressure canner.

**Home canned, 1 by open kettle, 3 by water bath, 3 by pressure cooker, 1 by oven.

***One home canned, steam pressure canner.

****Seven home canned, 4 by pressure canner, 2 by water bath, and 1 by open kettle.

*****Home canned, pressure cooker.

greens. Oven canning was seldom reported as the usual method of canning a particular vegetable.

Findings of this study in regard to method of canning used were not out of line with those of the study made by the Bureau of Agricultural Economics in 1945. In this study, 38 percent of farm homemakers reported using the open kettle method for canning tomatoes, 12 percent for other vegetables. Thirty-one percent reported using the water bath method for canning tomatoes; 43 percent in canning other vegetables. Eleven percent reported using the pressure canner for canning tomatoes; 35 percent for canning other vegetables.

From one-third to one-half of the homemakers reported canned string beans, mustard, English peas, and squash either drained or partly drained before heating, or drained after heating before adding seasoning. Canned asparagus, beets, cabbage, carrots, eggplant, kraut, okra, spinach, and turnip greens were reported by from 55 to 100 percent of the homemakers as usually drained or partly drained before heating, or drained after heating and before adding the seasoning. Pork and beans, tomatoes, and vegetable mixture were the only canned vegetables of which there were several records, where draining was not reported.

Twenty-three of the 59 women reporting on canned kraut stated that they not only drained, but also washed before heating. Seven reported soaking it in cold water before cooking. Other canned vegetables in which washing and soaking were reported by several were: string beans, cabbage, okra, and turnip greens.

Draining was more common in case of canned leafy vegetables than of canned legumes. However, the practice of draining varied among the different leafy and legume vegetables. For example, 81 percent of the homemakers stated that they drained kraut; 47 percent that they drained mustard greens. Thirty-seven percent reported draining English peas; 15 percent, field peas.

Salt pork was used much less often in seasoning canned vegetables than in seasoning fresh vegetables. In only two of the 22 canned vegetables for which there were records, turnip greens and string beans, pork was used more often than grease. Butter beans, squash, and spinach were most often seasoned with bacon or salt pork grease.

Favorite seasoning or ways of cooking fresh vegetables were, however, important in canned vegetables. For example, butter or oleo was an important seasoning for fresh carrots, English peas, and okra. It was often used also in seasoning canned carrots, canned English peas, and canned okra. Frying was an important method of preparing fresh eggplant and fresh okra. It was also frequently used in preparing canned eggplant and okra. Pickled beets was the favorite vegetable dish made from fresh beets. It was also the favorite from canned beets.

Canned tomatoes and vegetable mixtures were most frequently served in soup—usually a soup with water, fat and seasonings added. Meat or meat stock was used, but by about one-third of those reporting.

Some practices used with fresh vegetables, such as adding soda during cooking, were rarely reported in connection with preparation of canned vegetables. Only seven women giving information about preparing string beans stated that soda was added in cooking. Seven homemakers reported its use in connection with preparing canned tomato dishes. Its use was not mentioned in connection with preparation of the other 20 canned vegetables.

Sugar was about as frequently used in preparation of canned vegetables as it was in preparation of fresh vegetables. It was most often used in the preparation of canned beets, tomatoes, sweet potatoes, English peas, mustard, and turnip greens. Salt was not always added, since vegetables are salted in canning, and since they were often seasoned with salty grease or pork. However, when salt was used, the time of adding was very likely to be at the beginning of the preparation process.

In scheduling preparation of canned vegetables, homemakers seem to allow about one-half less time interval between starting to cook and serving than in the case of fresh vegetables (table 6). Holding period, as well as cooking period, of canned vegetables was less than of fresh vegetables. Thus median time between putting on to cook and serving fresh string beans was 135 minutes; of canned string beans, 60 minutes, for families in the schedule studies. For those in the record studies, median time between putting on to cook and completing cooking was, for fresh beans, 90 minutes; for canned beans, 45 minutes. Median time between completing cooking and serving was 30 minutes for the former, and 15 minutes for the latter.

As in the case of fresh vegetables, there was great variation in cooking time used by different homemakers.

It is interesting here to note that the fresh vegetables which received longest cooking period were usually the canned vegetables which also received longest cooking. Vegetables which received shortest cooking period when fresh, usually received it when canned. Thus, both fresh and canned string beans, field peas, and turnip greens received the longer cooking periods; both fresh and canned

Table 6. Median, minimum, and maximum time between putting canned vegetables on the stove and serving as reported by homemakers in the schedule studies; median, minimum, and maximum preparation time and time between completed cooking and serving canned vegetables, as recorded by homemakers in the record study.

Vegetable	Schedule studies			Record study					
	Time between putting on to cook and serving			Time between putting on to cook and completing cooking			Time between completing cooking and serving		
	Median	Min.	Max.	Median	Min.	Max.	Median	Min.	Max.
	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes
Asparagus	30	15	60	15	**	**	10	**	**
Beans, butter	30	20	80	28*	25*	30*	10*	0*	20*
Beans, pork and	30	10	30	15*	5*	30*	0*	0*	15*
Beans, string	60	15	120	45	15	90	15	0	50
Beets, roots	60	15	90	—	—	—	—	—	—
Cabbage	60	15	90	—	—	—	—	—	—
Carrots	30	15	60	—	—	—	—	—	—
Chard, Swiss	—	—	—	30	**	**	25	**	**
Corn	30	15	60	10*	5*	15*	15*	0*	30*
Eggplant	45*	30*	60*	—	—	—	—	—	—
Kraut	60	15	90	40*	20*	90*	15*	0*	30*
Mustard	60	15	90	—	—	—	—	—	—
Okra	30	15	60	—	—	—	—	—	—
Peas, English	30	15	90	20	5	90	15	0	60
Peas, field	60	15	120	53*	45*	60*	0*	0*	0*
Potatoes, sweet	30	15	60	—	—	—	—	—	—
Spinach	30	15	60	20	**	**	10	**	**
Squash	30	15	60	—	—	—	—	—	—
Tomatoes	30	5	120	20*	2*	60*	10*	0*	30*
Turnip greens	60	30	90	60	**	**	15	**	**
Pumpkin	60	**	**	—	—	—	—	—	—
Vegetable mixtures	30	15	90	30*	15*	45*	0*	0*	0*

*Two to nine records.

**One record.

English peas, okra, and spinach, the shorter cooking periods.

The practice of not consuming pot liquor was less common in canned than fresh vegetables, no doubt because so many homemakers drained canning liquid before seasoning. Fifteen women reported canned butter bean pot liquor; seven canned string bean pot liquor; three canned spinach and canned turnip green pot liquor, not consumed by the family. Pot liquor is seasoned liquid in vegetable at time of serving.

Dried Vegetables

Preparation reports of three dried vegetables (all legumes) were secured—butter) (lima) beans, navy beans, and field peas. (See table 2 in Appendix.) A total of 474 preparation reports was obtained, 29 in the record study and the remainder by personal interview with the homemaker.

Most homemakers stated that the dried peas and beans used by the family were purchased. As has already been pointed out, home canning or fresh butter beans and field peas was quite common. Evidently, these small-town women preferred to store the legumes they produced canned in the green state rather than dried.

Practices in soaking field peas and butter beans before cooking were similar (table 7). In both, overnight soaking was most common. Those not soaking overnight usually soaked 3 hours or less. Differences in soaking practices of butter beans and field peas and of navy beans may be accounted for by the fact that there were only 10 preparation rec-

Table 7. Soaking time of dry legumes reported by homemakers in record and schedule studies.

Legume	Percentage soaking legumes			
	Overnight or equivalent	1 to 3 hours	Less than 1 hour	Not at all
Butter beans	40	23	23	14
Navy beans	10	60	20	10
Field peas	41	22	24	13

Table 8. **Median, minimum, and maximum time between putting dried vegetables on the stove and serving, as reported by homemakers in the schedule studies. Median, minimum, and maximum preparation time and time between completed cooking and serving dried vegetables, as recorded by homemakers in the record study.**

Vegetables	Schedule studies			Record study					
	Time between putting on to cook and serving			Time between putting on to cook and completing cooking			Time between completing cooking and serving		
	Median	Min.	Max.	Median	Min.	Max.	Median	Min.	Max.
	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes
Beans, butter	120	60	240	—	—	—	—	—	—
Beans, navy	—	—	—	120	90	180	30	0	95
Peas, field	135	60	240	120	60	240	30	0	90

ords of navy beans, and 9 of these were furnished by Negro women. Seven homemakers reported adding soda to soaking water of butter beans; six, to soaking water of field peas. Fourteen women reported soaking butter beans and 21 soaking field peas in hot water rather than cold.

About one-fifth of those reporting on preparation of dry legumes parboiled them. Some women parboiled rather than soaked them, though a number reported both practices.

Dried legumes were usually started in cold water with a piece of raw salt pork. More than half of the women said they added the salt after the beans or peas were tender. These practices correspond rather closely with practices in connection with cooking the fresh beans and peas.

The principal differences in preparation of dry and fresh beans and peas were a longer cooking period for the dry beans and peas (table 8), and more frequent use of soda in cooking. Dry field peas were cooked a little more than were dry butter beans, and navy beans were cooked longest of all. The higher proportion of preparation records from Negroes than whites in the record sample than in the schedule samples may account for longer cooking periods used in the record group.

Fourteen homemakers reported using soda in cooking dry peas and 13 in cooking dry butter beans. Although the practice of adding soda was much more frequent than in the case of the fresh vegetables, it was followed by only one out of 20 women reporting.

Less than 1 percent of the group reported pot liquor not consumed by the family. The legumes were evidently cooked low and there was little if any pot liquor to consume.

Frozen Vegetables

Preparation reports of only six frozen vegetables were secured: butter beans, mustard, okra, English peas, field peas, and turnip greens. Only 37 reports were obtained (table 2 in Appendix). Most of these reports were secured from women in Marks and Tunica, the two towns with cold storage lockers. Use of frozen vegetables was limited to the higher rent or rental value white groups. No Negro family or white family with rent or rental value of $20 and less reported on the preparation of frozen vegetables.

Table 9. Source of frozen vegetables used and time scheduling in harvesting, in preparing for blanching, in blanching, and packing, and in taking to locker.

Item	Number of frozen vegetables reported					
	Butter beans	Mustard	Okra	English peas	Field peas	Turnip greens
Number reporting	13	1	2	5	13	3
Source:						
Purchased	3	0	0	2	5	0
Own locker	10	1	2	3	8	3
Harvested:						
Morning of day to locker	9	1	2	3	1	3
Afternoon before	1	0	0	0	7	0
Prepare for blanching:						
Morning	7	1	2	2	4	3
Morning and afternoon	2	0	0	1	3	0
Night and morning	1	0	0	0	1	0
Blanching and packing:						
Done at locker	3	0	0	2	2	0
Done in home	7	1	2	1	6	3
Morning	2	1	2	0	2	2
Afternoon	5	0	0	1	4	1
Take to locker:						
Morning	4	1	2	2	3	2
Afternoon	6	0	0	1	5	1

About two-thirds of those reporting on preparation of frozen vegetables reported on vegetables which they had put in the community freezer locker plant. As will be noted from table 9, vegetables obtained from the locker plant with the exception of field peas, were usually harvested the morning of the day sent to the locker plant. Field peas were most frequently harvested the afternoon before. Several women reported purchasing field peas from farmers who gathered them in the late afternoon and delivered them early the next morning.

Butter beans and field peas which took longer to prepare for blanching and packing were less likely to get to the locker plant in the morning. However, the number of records of other vegetables is limited. About half of the vegetables for which reports were given reached the plant in the morning, the remainder in the afternoon.

Blanching and packing of vegetables for the locker was done in the home, in three-fourth of the reports. It was done at the locker plant in the other fourth.

In 25 of the 37 reports on frozen vegetables, they were put on the range while still frozen. Two reported partly thawing and nine completely thawing. In one report it was stated that no set procedure was followed.

Starting the frozen vegetable to cook in a little cold water seemed to be the practice of the majority. Frozen vegetables were seasoned very much as were fresh vegetables, except butter or oleo was more frequently used in seasoning butter beans and English peas than in seasoning these vegetables when fresh. This may have been because families using frozen butter beans and English peas were in higher rent or rental value groups or groups in which use of butter or oleo for seasoning these legumes was more common. Salt pork was generally used in seasoning frozen field peas and frozen greens, as it was in seasoning these vegetables when fresh.

Median time from putting frozen vegetables on the range to serving was about half of that for fresh vegetables. Vegetables receiving longest cooking when fresh, that is, field peas, and turnip greens, received longest cooking when

Table 10. Median, minimum and maximum time between putting frozen vegetables on the stove and serving, as reported by homemakers in schedule studies.

	Time between putting on to cook and serving		
	Median	Minimum	Maximum
Vegetable	Minutes	Minutes	Minutes
Butter beans	30	15	60
Mustard	45	**	**
Okra	30*	15*	45*
English peas	30*	10*	45*
Field peas	60	15	110
Turnip greens	60*	30*	90*

*Two to five records.

**One record.

frozen (table 10). There was great variation in minimum and maximum interval between putting on to cook and serving reported by different homemakers preparing the same frozen vegetable.

Practices such as parboiling and addition of soda were not reported in cooking frozen vegetables.

The women reporting on preparation of frozen vegetables were asked if they considered the frozen vegetable: as good, not quite as good, not nearly as good, as the fresh vegetable. In 19 of the 37 reports, the homemaker stated as good, in 15 not quite as good, and in 3 not nearly as good. One woman reporting on frozen okra and two on frozen field peas reported them not nearly so good.

Raw Vegetable Dishes

Preparation reports of four kinds of raw vegetable dishes were secured: sliced tomatoes, cole slaw, other mixed vegetable salads, and congealed vegetable salad (see table 2 in Appendix). In all, 643 reports were obtained—121 in the record study and 522 in one of the schedule studies.

In preparing cabbage for slaw, two-thirds of those reporting said they cut the cabbage with a knife. Fourteen percent grated the cabbage and 3 percent ground it in a meat chopper. The remainder (about 16 percent) shredded it in a shredder.

About 10 percent of the women reporting on cole slaw said they generally used a dressing of vinegar and seasonings. Most of the others used either salad dressing or mayonnaise; less than 5 percent used French dressing. Salad dressings or mayonnaise were also used by the great majority on other mixed vegetable salads and congealed vegetable salads.

Vegetables most often reported used in other mixed vegetable salads and in congealed vegetable salads were tomatoes, celery, peppers, carrots, lettuce, onions, radishes and cabbage.

In table 11, time scheduling in connection with raw vegetable dishes is given. In the interval between completed preparation and serving, one-half of the lots of tomatoes in which there was an interval were kept in the refrigerator, the remainder on the dining table. Other raw vegetable dishes prepared ahead were as a rule kept in the refrigerator. However, about one-fourth of the homemakers reporting on cole slaw stated that they placed the slaw on the dining table as soon as preparation was complete.

Storage From One Meal to the Next

One of the questions on the forms used by homemakers keeping preparation records concerned whether the vegetable dish was eaten at another meal. If so, where it had been stored and how

Table 11. Median, minimum, and maximum time between starting to prepare and serving raw vegetables as reported by homemakers in the schedule studies. Median, minimum, and maximum preparation time and time between completed preparation and serving raw vegetables, as recorded by homemakers in the record study.

Vegetable	Schedule studies			Record study					
	Time between beginning preparation and serving			Time between beginning preparation and completing preparation			Time between completing preparation and serving		
	Median	Min.	Max.	Median	Min.	Max.	Median	Min.	Max.
	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes
Sliced tomatoes	—	—	—	**	—	—	10	0	70
Cole slaw	30	15	90	20	10	30	10	5	60
Other mixed vegetable salads	20	15	45	15	5	25	15	5	40
Congealed vegetable salads	—	—	—	20*	10*	30*	270*	180*	1380*

*Three records.

**Negligible.

prepared. Forty-nine percent of the cooked vegetable dishes for which records were kept were served at another meal, usually at supper. In the interval, a little more than one-half (54 percent) of the vegetables were stored in the refrigerator, about one-fourth on the dining table or in a cabinet, and the remainder in the oven, the warming oven, or on the top of the stove. All except 13 of the 160 families included in the record study owned a refrigerator.

The practice of storing left-over vegetables on the table, in a cabinet, or on the stove was a practice carried over from the time when there were no refrigerators. The factor responsible for continuation of this practice on the part of some is preference for vegetables such as those that remain at room temperature. Then, too, space is often limited in refrigerators. About one-fifth (21 percent) of the left-over cooked vegetables were heated before serving.

In 11 percent of the tomato records, 45 percent of the cole slaw records, and 30 percent of the other mixed vegetable salad records, there were left-overs for the next meal. However, in all cases, these were stored in the refrigerator in the interval between the two meals in which they were served.

Methods of Preparing Vegetables Compared With Recommended Procedures

Cooked Vegetable Dishes

Fresh Leafy Vegetables

Seventy-six percent of the homemakers questioned reported that all stems of greens were discarded. Forty-eight percent reported stripping centers (removing the midrib) when greens were old and tough, and 4 percent reported stripping centers always. Since stems and midribs have a lower mineral and vitamin content than do leaves, the practice of discarding stems and midribs is sound. This is especially true for families who produce their greens and have a large supply to draw from, as did families of this study. Also, by discarding tough stems and midribs, it is possible to reduce cooking time and hence, losses in cooking.

About one-half of the women reported that they tore up or stripped large leaves before cooking. Small leaves were generally cooked whole. About two-thirds reported that they cut cabbage in small pieces before cooking. These procedures shorten the cooking period and for this reason are desirable. However, when vegetables are cut up, losses in nutrients are greater if pot liquor is not consumed.

Soaking leafy vegetables in water before cooking was reported for about 10 percent of the leafy vegetables. This practice was much more common in case of collards and cabbage than other greens. According to recent investigations in nutrition, the loss of vitamins during soaking is small. Even though the loss is small, the practice is useless unless perhaps in case of wilted vegetables. How much cooking time is reduced and flavor improved by soaking wilted vegetables is not known. However, it is known that soaking wilted vegetables does not restore the vitamin C lost in wilting.

Most leafy vegetables were started to cook in boiling water, usually with a little partly-cooked salt pork. Collards and turnip greens were the leafy vegetables most often started in cold water. About one-fifth of the homemakers reported starting these two vegetables in cold water with raw salt pork. Nutrition specialists recommend starting all vegetables in boiling water to shorten cooking time and destroy oxidases.

Approximately one-third of the homemakers reported adding salt at the beginning of the cooking process; another third, during cooking; and the remainder, when tender. The practice of not adding salt until tender may have been passed down from the period when large amounts of salt were used in curing pork and when most vegetables were seasoned with salt pork. Food specialists recommend that salt be added at the beginning of the cooking period, as adding then tends to preserve ascorbic acid. It also helps to retain color of the green vegetable and improves flavor.

From 30 to 40 percent of the women added sugar to turnip greens, rape, collards, mustard greens, and kale. Nineteen percent added sugar in preparation of cabbage, 15 percent in preparation of chard, and 11 percent in preparation of tender greens. Less than 10 percent used sugar in preparation of spinach or beet tops. Adding a little sugar may improve flavor, especially if the vegetable is drained. Sugar is one of the flavoring substances that comes out in the cooking water.

Homemakers stated that vegetables were cooked with lid on except cabbage. In cooking cabbage, a number reported cooking without lid. Beginning to cook with the lid reduces the time it takes the vegetable to come to the boiling point. Cooking with the lid after the boiling point is reached conserves vitamin C and fuel.

Practices such as soaking in soda water, adding soda during cooking, and parboiling were not reported for the majority in cooking any of the leafy vegetables. Use of soda in preparation or during cooking of leafy vegetables was rare among white women, but fairly common among Negro women. It was more common in the schedule than in the record study. Recent investigations have demonstrated that a small amount of soda can be added provided cooking time is short.

Parboiling leafy vegetables was most common for spinach. About 14 percent reported parboiling. Cabbage, turnip greens, and mustard greens were other vegetables usually parboiled by a few homemakers. Parboiling was more common in the white than the Negro group. Nutrients are lost in parboiling.

According to the time table for cooking vegetables in the Handbook of Food Preparation[5] boiling time for beet greens is 5 to 15 minutes; for green cabbage quartered, 10 to 15 minutes; for Swiss chard, 10 to 20 minutes; for collards 10 to 15 minutes; for kale, 10 to 20 minutes; and for spinach, 3 to 10 minutes. Time for cooking mustard greens, rape, tender and turnip greens is not given. However, in School Lunch Recipes issued by the Bureau of Human Nutrition and Home Economics, a boiling time of from 10 to 20 minutes is given for mustard and turnip greens. Tendergreens are a tender variety of turnip greens, and rape leaves are somewhat similar in texture to cabbage leaves, but the leaves are deeply lobed. They are not hairy like those of the turnip.

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[5] Handbook of Food Preparation, American Home Economics Association, Washington, 1946, p. 41.

Evidently, the cooking times for collard, turnip, and mustard greens apply to very young vegetables. The more mature vegetables would certainly not get tender in time recommended. It requires a comparatively long time to tender fibrous mature leaves of these leafy vegetables.

Since information regarding cooking time obtained from cooperating homemakers in this study included time of putting the vegetable on the range, time of completing cooking and time of serving, it is not possible to make exact comparisons with recommended boiling time. It is, however, possible to make some rough comparisons. For example, recommended boiling time for turnip greens is 10 to 20 minutes. Median interval from putting turnip greens on the range to completing cooking in families in the record study was 80 minutes. Median interval from completing cooking turnip greens to serving in families in the record study was 30 minutes. Median interval from putting turnip greens on the range to serving by those in the schedule studies was 120 minutes. It would thus seem that even though greens were mature that excessive cooking periods were used by a number reporting.

Cabbage, collards, kale, mustard, rape, tender and turnip greens were the leafy vegetables which seemed to be most often overcooked. Spinach, Swiss chard, and beet tops were the vegetables which seemed to be least often overcooked. The former group of vegetables were those most often seasoned with salt pork; the latter group, those least often seasoned with salt pork. Intervals between putting on the range, completing cooking and serving were somewhat greater for Negro than for white families, somewhat greater for families in the schedule studies than in the record study. This was particularly true of Negro families in the record and schedule studies. Nutrition specialists recommend short cooking periods, to conserve vitamins. The practice of allowing a sufficiently cooked vegetable to remain on the back of the stove or in the warmer until served is destructive of vitamins.

Only 10 percent of the leafy vegetable records showed pot liquor not consumed by family members. Families in this study cooked vegetables down low, so that quite a number of women reported that there was very little pot liquor to consume. Discardiing pot liquor is, of course, one method of losing valuable nutrients.

Practices in preparing new cabbage and cabbage were similar. There is no reason why these practices should differ. Beliefs in the evilness of the first "messes" of leafy vegetables (on which traditional rules for preparing new vegetables are based) have no scientific basis.

Fresh Legumes

Forty-five percent of the homemakers in the schedule studies stated that they never shelled beans and peas more than one-half hour before cooking; 28 percent stated that they seldom did; and 27 percent that they often did. Seventy-six percent stated that they never purchased beans and peas already shelled. Twenty percent said they did sometimes, and 4 percent that they often did. Seventy percent of those shelling beans and peas ahead or purchasing them shelled kept these vegetables in the refrigerator until cooking time. The typical pattern followed by homemakers in the record study was to shell beans and peas shortly before cooking. However, about 8 percent of the lots for which preparation records were kept were shelled ahead. Research studies show that beans and peas stored in pods lose less vitamin C than if stored shelled, that losses are less when vegetables are stored in the refrigerator.

About three-fourths of the preparation records of the legumes reported that they were started to cook in cold water. As mentioned before, nutrition specialists recommend starting all vegetables in boiling water.

Butter or oleo was the most common seasoning used for English peas; salt pork, the most common seasoning for field peas (cowpeas) and butter beans (lima beans). About one-fourth of the cookings or lots of butter beans for which records were kept were seasoned with butter or oleo. Only 4 of the 124 lots of field peas were seasoned with butter or oleo.

In about one-half of the legumes records, it was reported that salt was not added until the vegetable was tender. The practice was as common in cooking English peas as in cooking field peas. In other words, salting after tender was not limited to legumes generally seasoned with salt pork.

About one-third of the homemakers reported addition of sugar to English peas. In about one-fifth of the butter bean records and one-tenth of the field pea records, it was added. Addition of sugar has no effect on nutritive value except in calories. It may improve flavor.

Boiling time given for green limas (butter beans) and for English peas in the Handbook of Food Preparation was 20 to 30 minutes for the former and 8 to 20 minutes for the latter. Boiling time was not given in Handbook for field peas (cow peas). However, fresh young peas should cook tender in 30 minutes. Median time between putting on the range to cook and completing cooking recorded was, for butter beans, 70 minutes; for field peas, 90 minutes. Median holding period for both was the same—30 minutes. Median interval between putting on the range and serving English peas was 60 minutes. It would thus seem that the majority of homemakers overcooked legumes. The practice of holding warm already overcooked legumes was also destructive of nutrients. In preparation of field peas there was a greater interval between putting on the range and serving than in case of the other 2 legumes. This was the legume most often seasoned with salt pork.

Practices such as soaking in water before cooking, parboiling, adding soda and discarding pot liquor were uncommon in connection with preparation of legumes. White homemakers in higher rent or rental value groups less often cooked legumes ahead than did those in lower rent or rental value groups. Negro homemakers more often cooked beans and peas ahead than white homemakers in the same rent or rental value group.

Roots and Tubers

Roots and tubers (except beets and sweet potatoes) were generally scraped, peeled or skinned before cooking. Baking was the method of preparation reported by 60 percent of the homemakers giving preparation information about sweet potatoes. Boiling or baking in jackets is a rule usually given by nutrition specialists.

Beets were always cooked whole, and all homemakers except 4 percent reported new Irish potatoes cooked whole. Carrots, turnips and rutabagas were almost always cut up before cooking.

About three-fourths of the lots of mature Irish potatoes of which preparation records were kept were sliced or cut up before boiling. About one-third of the homemakers reported onions and sweet potatoes cut up before boiling. When vegetables are cut across fiber, cooking losses are greater unless liquor is used.

Soaking of roots and tubers before cooking was not a common practice except for Irish potatoes. One-fifth of the homemakers interviewed about new Irish potatoes reported soaking them in water before cooking. In 14 percent of the mature boiled Irish potato records turned in, potatoes were soaked before cooking. Soaking potatoes for a short time is probably not very destructive of vitamins.

Boiling was the method of preparing beets, carrots, new Irish potatoes, rutabagas, and turnips. It was also the method most frequently used in preparation of onions and mature Irish potatoes. However, 27 percent reporting on onions and 18 percent on mature Irish potatoes gave preparation for fried onions and potatoes. Baking was the method most often reported for sweet potatoes. Only 4 percent of the preparation records of mature Irish potatoes were of baked Irish potatoes. Fried vegetables are not as easy to digest as are baked and boiled vegetables.

About 90 percent of the reports on boiled beets, new Irish potatoes, and onions, 80 percent of the reports on the mature Irish potatoes, nearly 70 percent of the reports on carrots and sweet potatoes, and 45 percent of the reports on rutabagas and turnips stated that vegetable was started to cook in cold water. The practice of starting roots and tubers in cold water may be related to the preparation rule, "Always put vegetables that grow under the ground on in cold water, and above the ground in hot water," which had been reported by several homemakers as taught by their mothers or someone else in the parental home.[6] This rule has no scientific basis.

The practice of draining before seasoning varied considerably among the different roots and tubers. Beets were always drained. New Irish potatoes were almost without exception drained. About 60 percent of the boiled mature Irish potatoes and 33 percent of the boiled sweet potatoes were drained. About 20 percent of those reporting on boiled onion and 16 percent on carrots reported draining. Nutrients are lost when the vegetable is drained, unless the vegetable is cooked with skin or peeling on.

Turnips and rutabagas were the only roots and tubers seasoned with salt pork. Butter or oleo was used in seasoning most of other roots and tubers except beets, which were not ordinarily seasoned with fat.

The practice of parboiling roots and tubers was rarely mentioned except for new Irish potatoes. Two hundred and fifty-two of the 400 families parboiled new Irish potatoes; 212 parboiled one time, 29 parboiled two times, and 11 parboiled more than two times. Only 72 of the 252 women parboiling new potatoes were Negro women. The rule, "Parboil new Irish potatoes," as has been shown in a previous publication, resulted from the fact that there have been persons made ill from eating new potatoes.[7] Most of the cases of illness reported are said to be due to bacterial infection. New potatoes, because of their higher content of water, decompose much more readily than old ones.

In preparing boiled or fried roots and tubers, salt (if added; it was not used by some homemakers in preparing beets and sweet potatoes) was most often added when the vegetable was tender or about done. As mentioned before, food specialists usually suggest addition of salt at the beginning of cooking.

Use of soda in cooking roots and tubers was rare. Pot liquor, when available, was generally consumed.

According to the time table for cooking vegetables in the Handbook for Food Preparation, boiling time for beets was 30 to 90 minutes, for sliced carrots 10 to 20 minutes, for onions 15 to 35 minutes, for medium whole Irish potatoes 25 to 40 minutes, for quartered Irish potatoes 15 to 25 minutes, for whole sweet potatoes 25 to 35 minutes, for quartered sweet potatoes 15 to 25 minutes, for sliced rutabagas 20 to 30 minutes, and for sliced turnips 15 to 20 minutes. Baking time given for Irish potatoes was 45 to 60 minutes, for sweet potatoes 30 to 45 minutes.[8/]

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[6] Traditional Food Preparation Rules, Dorothy Dickins, Miss. Agr. Exp. Sta. Bul. 418, June 1945, p. 29.

[7] Ibid, p. 25.

As will be noted, when comparing these boiling times with times listed in table 3, over-cooking of roots and tubers was less on the whole than overcooking of leafy vegetables and legumes. However, roots and tubers were overcooked, or at least kept warm, for excessive periods between completing cooking and serving. Longer cooking of turnips than of carrots may have been due to the fact that turnips were often cooked with salt pork. Another factor may be that carrots have been introduced into menus of many families fairly recently; that is, since the development of the science of nutrition.

All Other Fresh Vegetables

Before putting on to cook, eggplant, squash, tomato, and vegetable mixture were cut up or sliced. Corn was cut from the cob by 83 percent of those reporting. String beans were almost without exception broken up before cooking. Nearly 50 percent reported cauliflower broken into flowerets before boiling. Okra was usually cooked whole, except for frying. When breaking or cutting up before cooking reduces cooking time, it is desirable, especially if pot liquor is consumed.

Soaking in water before cooking was a practice rarely followed with these other vegetables, except in preparing cauliflower and eggplant. Soaking vegetables before cooking is probably a traditional practice, as evidenced by the fact that reference to soaking vegetables is found in old cook books.[9/]

String beans, cauliflower, corn, squash, tomato, and vegetable mixture were usually started in a little cold water. Okra was as often started in boiling as in cold water. Other methods than boiling were used more often in cooking eggplant and peppers. Eggplant was usually fried, peppers stuffed and baked.

String beans were most often seasoned with salt pork; corn and squash with salt pork or bacon grease; okra, tomatoes and vegetable mixture with butter or oleo; and cauliflower with butter or oleo, or white sauce.

The majority of homemakers reported cauliflower drained before adding seasoning. About one-third of the homemakers reported draining okra, squash, and eggplant. As before stated, nutrients are lost in draining.

Boiling time given in the Handbook of Food Preparation was, for string beans 15 to 30 minutes; for cauliflower whole 20 to 30 minutes; in flowerets 8 to 15 minutes; for corn on the cob 5 to 15 minutes; for eggplant sliced 10 to 20 minutes; for okra sliced 10 to 20 minutes; for summer squash sliced 10 to 20 minutes; and for tomatoes 7 to 15 minutes. Vegetable mixture with butter beans would take no more than 30 minutes.[10/]

As will be noted, in comparing these recommended boiling times with intervals between putting on the range, completing cooking and serving found in table 4, most of these other vegetables were overcooked, or kept warm for excessive periods after sufficient cooking. This seems to be especially true of string beans and tomatoes. A boiling time of from 15 to 30 minutes is given for string beans. Median interval from putting on the range to serving reported by homemakers in the schedule study was 135

[8/] Op. cit. A.H.E.A., p. 41.

[9/] Op. cit., Dickins, p. 20.

[10/] Op. cit. A.H.E.A., p. 41.

minutes. Time between putting on the range and completing cooking of those in the record study was 90 minutes.

The most common traditional rule reported by homemakers in the survey study, previously referred to, was one that implied that long cooked string beans were more tasteful.[11] It would seem that these traditional rules concerning cooking time of string beans were being followed at the present time to a large extent. Some of the rules were: "Cook string beans until they shrivel," "The longer you cook string beans, the better they are," "String beans have to be cooked a long time to be good."

Tomatoes in soup with meat were cooked considerably longer than tomatoes in soup without meat. Since fresh tomatoes require only a short cooking period, it seems desirable when using them in a mixture with other vegetables requiring longer cooking, to cook other vegetables and then add the tomatoes. Such scheduling will conserve vitamin C for which tomato is so valuable. Then, too, acid in the tomato delays other vegetables in getting tender. Preparation practices used in cooking string beans and new string beans differed little.

Canned Vegetables

In the majority of canned vegetables for which preparation reports were secured, the supply was stated as home canned. One-third or more of the women said they ordinarily used the open kettle method in canning cabbage, kraut, and tomatoes. The water bath method was most frequently used by 50 percent or more of those reporting on home canning of string beans, cabbage, and vegetable mixtures; the steam pressure method by 50 percent or more of those reporting on home canned corn, mustard greens, okra, squash, and turnip greens. Oven canning was seldom reported as the usual method of canning a particular vegetable. Food specialists recommend that tomatoes be canned by the water bath method and that all other vegetables be canned in the steam pressure canner. Scientific research has shown that these are the methods best suited for making harmless the organisms which are found on the vegetables.

Twenty-three of the 59 women reporting on canned kraut stated that they washed it before heating. Seven reported soaking it in cold water before cooking. Other canned vegetables in which washing and soaking were reported by several were: string beans, cabbage, okra, and turnip greens. It is possible these practices had been passed down from the period when excessive amount of salt had been used in making kraut, when canning acid or vinegar was used in canning nonacid vegetables. Washing and soaking canned vegetables are undesirable practices, both from the standpoint of palatability and nutrition. They are unnecessary when good canning practices are used.

From one-third to one-half of the homemakers reported canned string beans, mustard, English peas, and squash either drained or partly drained before heating, or drained after heating before adding seasoning. Canned asparagus, beets, cabbage, carrots, eggplant, kraut, okra, spinach, and turnip greens were reported by from 55 to 100 percent of the homemakers as usually drained or partly drained before heating, or drained after heating before adding seasoning. Many canned vegetables are more palatable if canning liquid is drained and quickly evaporated and then added to the vegetable. Other uses for canning liquid are in gravies, soups, and cocktails. Some of the minerals, vitamins, and flavor are dissolved in the liquid.

Canned vegetables were seasoned very much as were the vegetables when fresh. Salt pork was most often used in seasoning string beans and turnip greens, butter or oleo in seasoning carrots and okra. However, salt pork was used much less frequently—bacon or salt pork grease much more frequently—in seasoning canned vegetables than in seasoning fresh vegetables.

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[11] Op. cit., Dickins, pp. 28 and 29.

Practices such as adding soda during cooking and not consuming pot liquor were uncommon. Salt was not always used in preparing canned vegetables, since it had been added during canning and since canned vegetables were often seasoned with bacon or salt pork grease. When used, however, it was generally added at the beginning of the preparation process.

Sugar was used about as often in preparation of canned vegetables as in preparation of fresh vegetables. Adding a little sugar would replace the sugar dissolved from the vegetable during the canning process and would improve the flavor.

Canned vegetables are sufficiently cooked and, therefore, need to be heated and seasoned only. This is, however, not true of nonacid vegetables canned at home in the open kettle, water bath, or in the oven. Such vegetables should be boiled 10 minutes with lid on to insure destruction of organisms and toxins that may be present because of unsafe canning methods. Boiling 10 minutes is not necessary for nonacid vegetables canned by recommended methods; i.e., in a steam pressure canner, and for vegetables commercially canned.

From median intervals between putting on the range and completing cooking and between putting on the range and serving it would seem that most commercially canned vegetables as well as home canned vegetables were boiled more than 10 minutes. In fact, it is probably due to the practice of cooking thoroughly that there have been so few persons made ill from eating nonacid vegetables canned at home in the open kettle, water bath, and oven.

In scheduling preparation of canned vegetables, homemakers allowed about one-half less time between starting to cook and serving than for fresh vegetables. Holding period as well as cooking period of canned vegetables was also less than of fresh vegetables. There were some exceptions—canned cabbage, for instance. Intervals from putting on the range to serving were about the same as for fresh cabbage. There were only 11 reports of canned cabbage. It is not a palatable product (the flavor, texture and color are undesirable). Homemakers who can cabbage may be from families having low standards for cooked cabbage.

The great variation in scheduling used in cooking canned tomatoes resulted from different uses to which the tomato was put. Cooking and holding periods were greatest for tomatoes in soup made with beef. Long cooking periods of canned tomatoes is especially destructive of vitamin C.

Dried Vegetables

About 40 percent of the homemakers interviewed stated that they soaked beans and peas overnight, about 23 reported soaking 1 to 3 hours, about 23 percent less than 1 hour, and 14 percent not at all. Soaking before cooking shortens the cooking period and for this reason is desirable. However, soaking to shorten the cooking period must continue until the peas and beans have absorbed enough water to weigh nearly double their dry weight. If soaked in cold water this will take 7 or 8 hours; if put to soak in boiling water, probably 4 or 5 hours is sufficient. Negro homemakers much less often soaked peas and beans overnight than did white homemakers.

Seven homemakers reported adding soda to the soaking water of butter beans, six to the soaking water of field peas. Snyder found that one-eighth of a teaspoon of soda per pint of water was sufficient for soaking to shorten the cooking time except with very hard water.[12/] Soaked beans are lighter in color and less strong in flavor than nonsoaked ones.

About one-fifth of those reporting on preparation of dried beans and peas parboiled them. Some parboiled rather than soaked, though several reported both practices. Valuable nutrients are lost in parboiling.

Only a few homemakers reported using soaking water in cooking. Masters found that discarding the soaking water gave no greater loss than when the beans were cooked in water in which soaked.[13/]

Dried legumes were usually started in cold water with a piece of raw salt pork. As stated before, starting in cold water lengthens cooking time and increases cooking losses. More than half of those interviewed reported adding salt after beans or peas were tender. This practice is contrary to recommendations of food and nutrition specialists.

Adding soda during cooking was uncommon (only 6 percent reported its use). Soda added to the cooking water is likely to make the beans mushy on the outside, while the center is still hard. Addition of soda to the soaking water is preferrable to the addition of soda to the cooking water. Addition of soda is undesirable at any time, if the vegetable is overcooked or if used in excess.

Dried legumes require a longer cooking period than do fresh legumes. The time it takes to get tender differs somewhat with variety. "Good cooking" varieties of field peas and butter beans should get tender in a boiling period of one hour, provided the legumes have been softened by soaking. As will be noted, median time from putting on to cook and serving was, for dried butter beans, 2 hours; for dried field peas, 2¼ hours (table 8). One factor in longer cooking may have been failure to soak sufficiently before cooking. Long cooking periods increase loss of nutrients. Intervals between putting on the stove and completing cooking, between completing cooking and serving, between putting on the stove and serving, were greater for Negro than for white women.

Pot liquor from dry peas and beans was almost always consumed by family members.

Frozen Vegetables

About two-thirds of those reporting on preparation of frozen vegetables gave information on vegetables which they had put in the community freezer locker plant. Vegetables sent to the plant except field peas were usually harvested the morning of the day carried to the locker plant. Field peas were generally harvested the afternoon before. Vegetables were as a rule prepared for blanching in the morning, or morning and afternoon. Blanching and packing were reported as done at home for three-fourths of the vegetables. In the remainder it was done at the locker plant. About one-half reported that vegetables were taken to the locker in the morning; the other half that they were taken in the afternoon. One should aim at a maximum time of two hours from garden to freezer (and try to make it less), since a short interval means better vegetables. Preparing vegetables for freezing is often quite time consuming, and too large an amount should not be prepared on any one day. It is desirable to do the blanching and packing of vegetables at home, unless there is sufficient assistance at the locker plant to take care of the vegetable soon after it is brought to the locker.

In 25 of the 37 reports on frozen vegetables, they were put on the range to cook

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[12/] Some Factors Affecting the Cooking Quality of the Pea and Great Northern types of dry beans, E. B. Snyder, Neb. Agr. Exp. Sta. Research Bul. No 85 (1936).

[13/] Masters, H., Dried Legumes (An investigation of the methods employed for cooking vegetables with special reference to losses incurred), Biochem. Jour. 12:231-247 (1918).

frozen. Two reported partly thawing and nine completely thawing. In one report it was stated that no set procedure was followed. It is unnecessary and undesirable to thaw most frozen vegetables prior to cooking. If they are thawed completely, they lose a high percent of the vitamin C and some flavor. However, corn on the cob must be thawed, or the cob may still be frozen when kernels are cooked.

Starting the frozen vegetable to cook in a little cold water was the usual practice. The recommended procedure is to put a small amount of lightly salted water in the sauce pan (¼ to ½ cup of liquid is enough). Bring the liquid to boil, add frozen vegetable, and when boiling starts again, cover the pan tightly. After 2 or 3 minutes, break the melting mass of food apart with a fork so the heat will reach all parts evenly, then cover again.

Frozen vegetables were seasoned very much as were fresh vegetables, except butter or oleo was more frequently used in seasoning butter beans and English peas than in seasoning these two vegetables when fresh.

Practices such as parboiling and addition of soda were not reported in cooking frozen vegetables.

Median time from putting frozen vegetables on the range to serving was about half the time used for the fresh vegetable. Cooking time for frozen vegetables is just about half that for fresh vegetables. It is less since frozen vegetables have been partially cooked in the blanching process and since freezing softens the tissues still further. Cooking and/or holding periods for fresh vegetables were for the majority of families excessive. Therefore, cooking and/or holding periods for frozen vegetables were for the majority of families excessive.

Raw Vegetable Dishes

In preparing cabbage for slaw, two-thirds of those reporting said they cut the cabbage with a knife. Fourteen percent grated the cabbage and 3 percent ground it in a meat chopper. The remainder (about 16 percent) shredded it in a shredder. Grating, grinding, shredding in a shredder are destructive of vitamin C. Cabbage for slaw should be cut with a sharp knife.

Soaking vegetables in cool water before making into salad was no more common than was soaking leafy vegetables to be boiled.

For the majority, there was a short interval between completing preparation and serving; for a few quite a long interval. About one-half of those reporting on sliced tomatoes and one-fourth on cole slaw stated that the salad was placed on the dining table when preparation was complete. Losses would be greater if stored on the table rather than in the refrigerator.

Storage From One Meal to the Next

Forty-nine percent of the cooked vegetable dishes for which records were kept were served at another meal, usually at supper. In the interval, a little more than one-half (54 percent) of the vegetables were stored in the refrigerator, about one-fourth on the dining table or in a cabinet, and the remainder in the oven, the warming oven, or on the top of the stove. In 11 percent of the tomato records, 45 percent of the cole slaw records, and 30 percent of the other mixed vegetables salad records, there were left-overs for the next meal. These salads were in all cases kept in the refrigerator in the interval between the two meals in which served. Losses in nutrients are less when refrigerator storage is used.

SUMMARY

This study reports methods used in preparation of 9,246 vegetable dishes by 844 families in six small towns of Mississippi.

Two methods of securing the information were used: (1) The record method, whereby detailed day-by-day records of steps in preparation of particular vegetables served during the report week were kept by 80 white and 80 Negro homemakers. (2) The schedule method, whereby 440 white and 244 Negro homemakers were interviewed with the use of schedules concerning preparation of vegetables.

Great variation was found in preparation practices used by different families. In no one step in preparation did all homemakers report good practices (practices recommended by food and nutrition specialists), nor did all homemakers report poor practices. However, in some steps in preparation, the majority used good practices; in other steps in preparation, the majority used poor practices.

Good preparation practices reported by the majority were:

(1) Discarding stems and stripping old and tough midribs of leafy vegetables.

(2) Starting leafy vegetables in boiling water.

(3) Cooking vegetables with lid on.

(4) Shelling peas and beans shortly before cooking.

(5) Using baking as the principal method of preparing sweet potatoes.

(6) Blanching and packing vegetables to be frozen, at home rather than taking to locker plant where facilities for prompt handling are not usually available.

(7) Starting frozen vegetables to cook frozen.

(8) Cutting cabbage for slaw or salad with a knife rather than grating, grinding, shredding in shredder.

(9) Preparing raw vegetable dishes just before using, or if ahead, placing in the refrigerator during the interval.

(10) Consuming vegetable pot liquor.

(11) Storing left-over cooked and raw vegetable prepared dishes in the refrigerator.

Poor preparation practices reported by the majority were:

(1) Not adding salt to the vegetable until tender.

(2) Excessive cooking of vegetables—cooking longer than is needed to be tender.

(3) Keeping vegetables warm for a period before serving after sufficiently cooked.

(4) Starting legumes, roots, and tubers to cook in cold water.

(5) Little use of baking as a method of preparing Irish potatoes.

(6) Not making use of water drained from vegetables before seasoning, especially canning liquid.

(7) Parboiling new Irish potatoes.

(8) Canning tomatoes by methods other than water bath method. Canning other vegetables by methods other than steam pressure canner.

(9) No soaking or inadequate soaking of dry legumes.

(10) Too great an interval between harvesting vegetables for freezing and putting in quick freezer.

Negro homemakers reported more poor practices in preparation of vegetables than did white homemakers. Greater number of poor practices in the Negro family is particularly serious, since Negro families usually have low incomes. Low-income families are more likely to have an inadequate supply of food than are higher-income families.

The traditional preparation rule concerning parboiling new vegetables (the first "mess" or "messes" of a vegetable harvested) was not being followed to any extent except in preparation of new Irish potatoes.

Preparation practices seem associated. For example, those who cook collard greens excessively are more likely to add soda during cooking.

Improving Vegetable Preparation

One likes what one is used to. Since this is true, family members may like vegetables cooked by methods using poor practices. Evidence that they did is that only 50 persons were reported as not eating the cooked vegetable dishes; only 7 as not eating the raw vegetable dishes for which records were kept.

Herein is a real challenge to the homemaker: To teach members of her family to like vegetables prepared according to good practices. To do this job effectively may mean first of all learning herself to like vegetables prepared by good practices. If the homemaker does not like vegetables prepared according to good practices, family members usually know it. Teaching members of the family to like well prepared vegetables will certainly mean knowing what good preparation practices are. Good practices are not the same today as they were yesterday. They depend on research findings and developments in processing. If one is using vegetable preparation rules learned when a child, one is not using practices recommended by food and/or nutrition specialists.

Some pointers for improving vegetable preparation:

(1) In cooking mixtures with vegetables, start with the ingredient requiring most cooking and add later ingredients requiring less cooking. (For example, in preparing vegetable soup with fresh vegetables, start with soup bone. Boil it until practically tender, add butter beans and other vegetables requiring 20 to 30 minutes boiling, add tomatoes about 10 minutes before serving.)

(2) Avoid the use of tough vegetables. Follow rules of successive planting.

(3) In preparing vegetables not before served to the family, be sure to use good preparation practices. Establish good habits for new vegetables.

(4) Watch storage between completing cooking and serving. If, because of other duties, vegetables must be prepared ahead, slightly undercook, if storage period is to be short; complete cooking, cool quickly, put in the refrigerator, and heat just before serving, if storage period is to be long.

(5) If in the habit of excessive cooking of vegetables, gradually reduce cooking time. Family members are less likely to notice changes when gradually made.

(6) If accustomed to excessive cooking of vegetable with salt pork, reduction in cooking time will be noticed less if seasoning is changed, as there may be an association in flavors from long cooking and seasoning. For example, if turnips have been excessively cooked with salt pork, try the following method: Peel, slice, boil quickly in a little salted water, drain (the little cooking water is delicious in vegetable soup), add a little milk, oleo or butter, and black pepper. Heat and serve.

(7) Recommendations of food and nutrition specialists concerning preparation of vegetable change as research findings and developments in processing are made available. Homemakers must keep up-to-date in vegetable cookery, if they want to use good practices. This means joining clubs, attending demonstrations where such information is given, reading, consulting one's home demonstration agent, home economics teacher or Farmers Home Administration home supervisor. Old cook books or methods learned when a child cannot be relied upon.

APPENDIX

I. Forms used in obtaining information concerning vegetable preparation.

A. In record Study
Cooked vegetables **SCHEDULE (d)** **Family No.**__________
I. Housewife fills out

DATE SERVED				
NAME OF VEGETABLE				
If fresh veg. young, average maturity, very mature				
Time started to prepare: washing, peeling, shelling, soaking, opening can				
If canned, was water drained off? If dried, was veg. soaked? Was veg. cooked in water in which soaked?				
Recipes (measures or weights)				
Container in which cooked. If steam pressure, give pressure used				
Drained and more water added. Number times. Drained at end				
Time vegetable put on stove				
Time cooking complete				
Time served				
If interval, where kept until served?				
Was all pot liquor eaten? If not, give total no. cupfuls in all and no. cupfuls not eaten				
Used next meal? If so, where and how stored? How prepared for next meal?				

II. Supervisor fills out

If home produced, when gathered and by whom?				
If purchased, when?				
Where and how had vegetable been stored in interval between gathering or purchasing and preparing?				
Parts discarded in preparation				
Was veg. soaked in water after being cut up before put on to boil? If so, how long? Kind of water soaked?				
Was veg. cooked whole, cut in halves, in quarters, in smaller pieces, shredded?				
Was veg. put on in boiling water or cold water, or in hot moderate oven, or in hot or moderate grease?				
Was vegetable cooked with or without cover?				
When were seasonings added?				
Anything added to tender or to cook quicker?				
Who prepared vegetables?				
From whom was method learned?				
Members of family not eating vegetable?				

Food Preparation

SCHEDULE (e) **Family No.**__________

Vegetable salad **I. Housewife fills out**

DATE SERVED

NAME OF SALAD				
If veg. raw: young, average maturity, very mature				
Time started to prepare salad. Were veg. crisp or wilted?				
What use was made of water if canned veg. was used?				
Recipe (measure or weight)				
Time preparation complete				
If time between finished preparing and mealtime, how long; where was salad kept?				
Was it used at next meal? If so, where and how stored between meals?				

II. Supervisor fills out

If home produced, when gathered and by whom?				
If purchased, when?				
Where and how had veg. been stored in interval between gathering or purchasing and preparing?				
Parts discarded in preparation				
Were vegetables cut or shredded with knife, grated, cut in meat chopper, shredded in shredder?				
Were vegetables soaked in water after being cut up?				
If potato salad, cooked with or without peelings; if without, was water discarded?				
Who prepared salad?				
From whom was method learned?				
Members of family not eating salad				

B. IN SCHEDULE STUDY

SCHEDULE I

Name .... Schooling of homemaker* ....
Address .... Schooling of man head* ....
Color .... Size of family* .... Occupation of man head or family head*
....
Owns home* .... Does not own home* .... Monthly rent or rental value* ....

I. Is enough vegetable cooked at dinner:

		Reheated at supper	Where stored
(a) for supper:	In winter	....	....
	In summer	....	....

		Reheated for dinner	Where stored
(b) for dinner:	In winter	....	....
	In summer	....	....

II. What time is dinner usually started now .... What time in winter ....
What time in summer ....

III. (a) Are green butter beans and peas shelled more than ½ hour before cooking:
often .... sometimes .... never ....

(b) Are they purchased shelled: often .... sometimes .... never ....

(c) If shelled ahead or purchased shelled, state how and where stored until cooked ....

IV. When preparing greens in good condition, what parts are discarded: all stems .... tough stems .... large center midribs .... tough center midribs ....

V. Do you cook vegetables with lid off or on ....

VI. Was yesterday's menu typical of a week day menu for this season of the year? If not, how different? ....

VII. Was number of meals and time of serving yesterday typical of what you usually do: in winter? (If not, give number meals served and time) ....

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*This information not asked of families included in the initial survey study, since it was obtained at that time.

....

in summer? (If not, give number meals served and time) ....

....

VIII. List dishes served yesterday and time served: ....

Meal	Time	Meal	Time	Meal	Time

IX. Where do you get most of the fresh vegetables you use **in summer:** from grocery.................... from peddlers .... from neighbors.................... raise..................... **In winter:** from grocery.................... from peddlers.................... from neighbors.................... raise....................

X. How often shop for food: once a week.................... twice a week.................... every other day.................... every day.....................

XI. If **raise green vegetables,** time usually gathered: day before.................... morning of day eaten: before breakfast.................... after breakfast..................... If gathered day before or before breakfast, where kept until prepared....................

XII. Kind of fuel used in cooking: winter.................... summer....................

XIII. Do you have a mechanical refrigerator.................... ice refrigerator.....................

If ice refrigerator, number months with ice in refrigerator all time.....................

XIV. **If a Negro family,** answer:

Has anyone in present family ever cooked in the home of a white family? .... Has anyone in present family ever eaten regularly in home of a white family?.................... Did parents of husband or wife ever cook in the home of a white family?.................... Did parents of husband or wife ever eat regularly in home of a white family?.....................

XV. **If a white family,** answer:

Does family ordinarily have a cook?.................... If so, what does homemaker do: cook along with cook.................... closely supervise cooking, but cooks little herself.................... Turn cooking over to cook.....................

SCHEDULE 2

Fresh Vegetable—Cooked

Item	*	*	*	*	*	*
Where get most of what is used						
Temp. of water in which washed; salt, soda, soap						
Soak; time; water temp.; salt, soda, vinegar. Cook in soaking water						
Is veg. peel, scrape, broken, slice, quarter, shred? If so, before or after soaking						
Amt. water started: none, little, ½ cov., cov., more than cov.						
Parboil or drain: number times; length each time; soda to tender						
Is veg. started: water cold, hot; grease hot, mod. oven hot, mod.						
When salt added						
Boiler: simmer, boil; frying pan; steamer; pressure cooker; oven						
Fat and milk: oleo, partly cooked salt meat; raw salt meat; butter; lard; grease; milk; white sauce; when						
Other ingredients added, and when, including sugar						
Anything ever added in cooking to make easier to digest, cook quicker, as soda, vinegar						
Time usually start cooking						
Is there pot liquor						
If so, is it all eaten						

*Names of vegetables were inserted in these spaces. Ackerman, Eupora, Marks, and Tunica families questioned about preparation of turnip greens, mustard greens, collards, cauliflower, cabbage, spinach, carrots, rutabagas, string beans. Calhoun City and Friars Point families were questioned about new Irish potatoes, sweetpotatoes, new cabbage, English peas, onions, squash, beets, corn, eggplant, Swiss Chard, beet tops, tender greens, spinach, kale, rape, new string beans, leaf lettuce, turnips (roots).

SCHEDULE 3

Canned Vegetables

Item	*	*	*	*	*
Pur. or H.C. If H.C. open kettle, water bath, pressure cooker					
Is liquid drained, partly drained, not drained					
Is veg. washed or soaked before cooking? If soaked, cook in soaking water					
Is veg. started water cold, hot; grease hot, moderate; oven hot, mod.; own liquor cold; own liquor hot					
Fat and milk: oleo; P.C.S. meat; r.s. meat; butter, lard, grease, milk, white sauce; when					
Other ingredients added, include salt; when					
Method cooked: in boiler—simmer, boil; frying pan; steamer; pressure cooker; oven					
Is veg. drained after cooked					
Time usually start cooking					
Time usually eaten					
Is there pot liquor					
If so, is it all eaten					

*Names of vegetables were inserted in these spaces. Ackerman, Eupora, Marks, and Tunica families questioned about preparation of canned asparagus, string beans, English peas, and tomatoes. Calhoun City and Friars Point families were questioned about canned vegetables other than string beans, English peas, and tomatoes.

SCHEDULE 4

DRIED VEGETABLES*

SAME AS SCHEDULE 2

*Information obtained on the two most common dried vegetables: dried cowpeas and dried lima beans. Only Ackerman, Eupora, Marks, and Tunica families were questioned about preparation of dried vegetables.

SCHEDULE 5

Frozen Vegetables

Item	*	*	*	*	*	*
Source						
Harvest: when To locker: when						
Prepare for locker: who and when						
Blanch, pack: who and when						
If interval bet. packing and to locker, where stored						
To cook frozen; partly frozen; thaw						
Amount water started: none, little, ½ cov., cov., more than cov.						
Is veg. started: water cold; grease hot, moderate						
When salt added						
Simmer; boil; steamer; pressure cooker; oven						
Fat: oleo; partly cooked salt meat; raw salt meat; butter; lard; grease; when						
Ingred. other than salt and fat added; when (including sugar)						
Parboiled; number times; length each time; soda to tender						
Anything ever added to tender in cooking, cook quicker, as soda, vinegar						
Time usually start cooking						
Time usually eaten						
Is there pot liquor? If so, is it all eaten? If not, disposal made						
How compare in flavor with fresh?						

*Names of vegetables were inserted in these spaces. Only Ackerman, Eupora, Marks, and Tunica families were questioned about preparation of frozen vegetables.

SCHEDULE 6

Vegetable Salads

Item	*	*	*	*	*
Vegetables used					
Seasonings and/or dressing					
Other ingredients					
Time prep. of salad started					
Time salad eaten					
Are veg. chop or cut with knife; grated; ground; shred in shredder					
Is veg. soaked in water after cut up? If so, how long? Salt, soda, vinegar					
Is there usually salad left from one meal to next? If so, where and how kept until next meal?					

*Names of salads inserted in these spaces. Only Calhoun City and Friars Point families were questioned about preparation of vegetable salads.

II. TABLES

Table 1. Occupational distribution of family heads of record and schedule families, classified by rental value and race.

Occupation of family head	White families—rental value					Negro families—rental value			
	$20.00 & under		$20.01-$40.00		Over $40	$7.50 & under		$7.51-$20.00	
	Record	Schedule	Record	Schedule	Schedule	Record	Schedule	Record	Schedule
	Percent		Percent		Percent	Percent		Percent	
Manager, clerk	22.0	21.7	46.2	29.8	27.8	2.5	0	0	2.0
Professional and business	17.1	6.3	35.9	32.1	38.9	2.5	.7	17.1	4.9
Farmer*	7.3	5.3	10.3	9.8	22.3	10.3	22.4	14.6	19.8
Wage earner	46.3	53.4	5.0	19.5	5.5	82.1	63.6	61.0	59.4
No occupation**	7.3	13.3	2.6	8.8	5.5	2.6	13.3	7.3	13.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of families	41	189	39	215	36	39	143	41	101

*Includes plantation owners as well as farm wage hands.

**Includes families living from dependency allotments, pensions, relief, and investments.

Table II. Number of vegetable preparation records secured in record and schedule studies.

Vegetable dish	Record study (160 families)	Schedule study No. 1 Survey towns (266 families)	Schedule study No. II at Calhoun City and Friars Point (418 families)	Total (844 families)
Cooked vegetables				
Fresh:				
Beets, greens	0	—	29	29
Beets, roots	3	—	346	349
Beans, butter	145	—	—	145
Beans, butter and string mixed	2	—	—	2
Beans, string	50	259	—	309
Beans, new string	0	—	412	412
Beans, string, shelled	2	—	—	2
Cabbage	50	243	—	293
Cabbage, new	0	—	319	319
Carrots	13	124	—	137
Cauliflower	1	23	—	24
Chard, Swiss	2	—	14	16
Collards	14	192	—	206
Corn	87	—	408	495
Eggplant	5	—	155	160
Kale	0	—	38	38
Lettuce	0	—	1	1
Mustard greens	1	253	0	254
Okra	82	—	—	82
Onions	6	—	179	185
Peas, English	0	—	292	292
Peas, field	124	—	—	124
Peas, field and butter beans mixed	2	—	—	2
Peppers	4	—	—	4
Potatoes, Irish	137	—	—	137
Potatoes, new Irish	0	—	400	400
Potatoes, Irish, and butter beans	1	—	—	1
Potatoes, Irish, and string beans	1	—	—	1
Potatoes, sweet	12	—	402	414
Rape	0	0	28	28
Rutabagas	1	92	—	93
Squash, summer	12	—	311	323
Spinach	4	101	208	313
Tomatoes	21	—	—	21
Turnip roots	1	—	314	315
Turnip greens	23	265	—	288
Tender greens	0	—	147	147
Vegetable mixtures	19	—	—	19
Canned:				
Asparagus	1	9	16	26
Beans, butter	2	—	170	172
Beans, pork and	4	—	19	23
Beans, string	10	227	—	237
Beets, roots	0	19	—	19
Cabbage	0	—	11	11
Carrots	0	—	31	31
Chard, Swiss	1	—	0	1
Corn	3	—	240	243
Eggplant	0	—	8	8
Kraut	3	—	77	80

Table II. (Continued)

Vegetable dish	Record study (160 families)	Schedule study No. 1 Survey towns (266 families)	Schedule study No. II at Calhoun City and Friars Point (418 families)	Total (844 families)
Mustard	0	—	15	15
Okra	0	—	71	71
Peas, English	24	214	—	238
Peas, field	2	—	104	106
Potatoes, sweet	0	—	12	12
Spinach	1	—	21	22
Squash	0	—	46	46
Tomatoes	6	246	0	252
Turnip greens	1	—	57	58
Pumpkin	0	—	1	1
Vegetable mixtures	2	—	38	40
Dried:				
Beans, butter	0	215	—	215
Beans, navy	10	—	—	10
Peas, field	19	230	—	249
Frozen:				
Beans, butter	0	13	—	13
Mustard greens	0	1	—	1
Okra	0	2	—	2
Peas, English	0	5	—	5
Peas, field	0	13	—	13
Turnip greens	0	3	—	3
Raw vegetables				
Tomatoes, sliced	75	0	0	75
Slaw, cole	18	0	272	290
Other mixed vegetable salads	25	0	250	275
Congealed vegetable salads	3	0	—	3